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“BOTIJO” FLOWERS THAT REFRIGERATE THEMSELVES IN THE HOT-DRY MEDITERRANEAN SUMMER

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Study Description

In the torrid Mediterranean summer of southern Spain, the interior of the flowerheads of the thistle *Carlina corymbosa* (Asteraceae) was cooler than the surrounding air most of the time. The internal thermal deficit was highest from noon through early afternoon, the period when ambient temperature reached the daily maxima. Cooling inside *C. corymbosa* flowerheads was most likely achieved through enhanced transpiration, an effect similar to that exploited by human cultures from hot-dry environments under the form of sweating pitchers made of porous clay, “botijos” in Spanish, which can achieve large temperature drops relative to the ambient through intense evaporation.



Photo 1. The Mediterranean-type climate that prevails over most of the Iberian Peninsula is characterized by torrid summers, and very few plants bloom during that harsh season. The thistle *Carlina corymbosa* (Asteraceae) is a conspicuous exception to this rule, their yellow flowerheads being a distinctive hallmark of summertime in open, sunlit Mediterranean habitats. The picture shows flowering *Carlina corymbosa* plants at the mid-elevation (top, open *Quercus ilex* woodland) and mountain (bottom, clearing in *Pinus nigra* forest) study sites. Pictures taken in August. Photo credit: Carlos M. Herrera.



Photo 2. The large thermal deficit inside *Carlina corymbosa* flowerheads at high ambient temperatures was most likely achieved through a “botijo” effect. Sweating pitchers made of porous clay (*botijos* in Spanish) as those shown in the picture have been used traditionally as a water-chilling technique by human cultures from the Mediterranean Basin and other hot-dry areas of the world. Through intense water evaporation, they can achieve temperature drops inside of up to 20°C relative to the ambient, depending on clay porosity and environmental conditions (temperature, humidity, wind speed). The display of the data logger in the picture shows the temperatures of the water inside the less-porous red (Channel T1, 19.2°C) and highly-porous yellow (Channel T3, 16.3°C) botijos, and the respective air temperatures outside (Channel T2 and T4, 23.9°C). Photo credit: Carlos M. Herrera.



Photo 3. The main pollinators of *Carlina corymbosa* at the study sites were females of medium- and large-sized bees in the families Apidae (e.g., *Anthophora fulvodimidiata*, top) and Megachilidae (e.g., *Megachile apicalis*, bottom) which are active during the hottest interval of daytime and could risk overheating while foraging for extended periods in the scorching summer sunshine. Flowerheads cooler than the air will possibly be more attractive to bees and have greater pollination success. Photo credit: Carlos M. Herrera.

These photographs illustrate the article “Refrigerated flowers in the torrid Mediterranean summer” by Carlos M. Herrera published in *Ecology* 105: e4268. <https://doi.org/10.1002/ecy.4268>