Morphological Variability of Xoconostles or Acidic Cactus Pears (*Opuntia* spp.) from North Central Mexico

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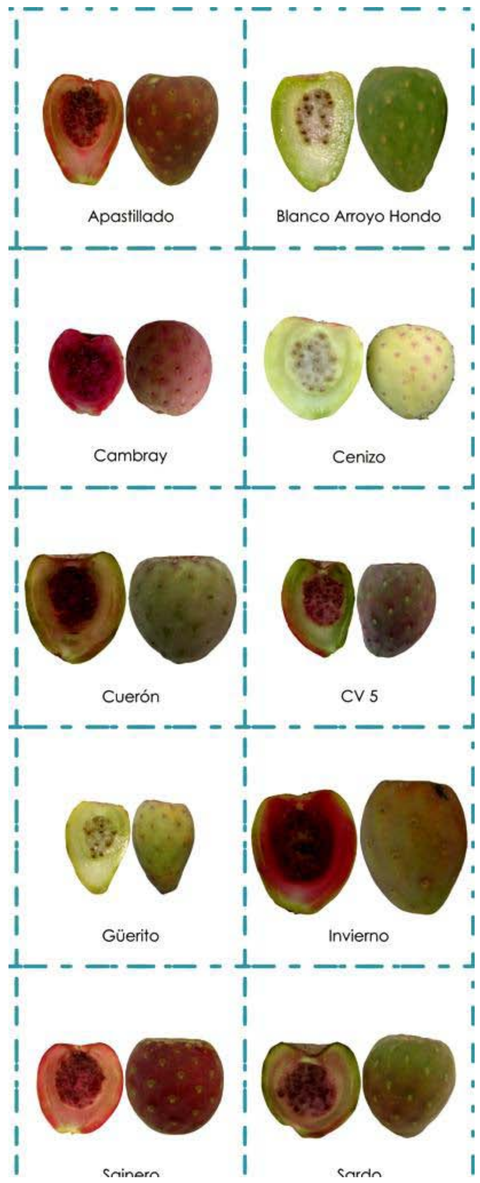
INTRODUCCIÓN

Xoconostles or acidic cactus pears (*Opuntia* sp.) as described by their Aztec name (xoco=acid; noxtle=pear-like) are produced by a specific cactus pear plant bearing fruits prized by its fleshy, acidic mesocarp, morphologically different from its cousins the cactus pears which are recognized by its sweet, juicy and seedy endocarp. Xoconostles thrive under semiarid conditions of the highlands of Central Mexico, tolerant to poor, stony soils and scanty rainfall, they evolved into formal crop during the last two decades (Gallegos, et al.,2009). Xoconostle fruits are recognized by their edible, thick peel and hard-coated seeds, loosely packed in the central part of the fruit, which is scooped out before consumption. After ripening they can remain attached to the pad or cladode almost a year, a valuable agronomic feature, probably associated to the low rate of ethylene released during ripening (Ávalos-Andrade *et al.* 2006). Xoconostles have been an important plant resource for traditional farmers who routinely utilize the fruits in the daily diet, usually slicing and mixing with tomatoes, onions and hot peppers. Adding xoconostle to salsas confers them a special, zesty, acidic flavor. They can also be a base for refreshing drinks, whole fruits are caramelized or dehydrated or the juice made into liquors. They are recognized as an alternative medicine due to its hypoglucemic effects, high cholesterol control and body weight reduction (Olivares-Orozco *et al*., 2003). Guzmán-Maldonado et al.,2010, reported that xoconostle peel is an outstanding source of fiber, minerals, simple soluble phenolics, and betalains. A 100 g portion of peel and skin could contribute up to 58% and 13% of daily iron and zinc requirements, respectively. The peel and skin showed significantly higher TEAC than strawberry, raspberry, red plum, grapefruit, orange, pear, and apple (2.59, 1.85, 1.83, 0.86, 0.85, 0.28, 0.34 mm TE/100g FWB, respectively) (Proteggente et al.,2002). In this presentation we describe the main cultivars of xoconostle from Central Mexico using 24 traits collected from cladode, flowers and fruits following UPOV guidelines, we also discuss the morphological relationships among these cultivars.



MATERIALS AND METHODS

Plant material. Samples of 20 accessions were collected at two locations; a private orchard at Villa de Tezontepec Hidalgo and wild stocks of Saín Alto, Zac., which together contain the most important cultivars for the fresh fruit trade and agroindustrial applications. Overall 27 traits were selected for morphological description, regarding cladodes; length, width, thickness, number of rows of areoles, number of areoles in central row, number of thorns in central areole, length of central thorn. Flower variables; length, length and width of pericarpel, number of lobes of stigma. Fruit variables: length, diameter, length/diameter ratio, areole density, peduncle length, receptacle depth, diameter, peel thickness, total weight, peel weight, pulp weight, pulp/peel ratio, number of fully developed seeds, total soluble solids and acidity. To find out the relevant variables for morphological description a correlation matrix was built, thereafter a principal components analysis was performed considering the complete dataset. The significant variables (14) were subjected to a cluster analysis using the squared Euclidean distance and the minimal variance of the Ward´s method (Ward, 1963). The relationships among the clusters were elucidated by discriminant canonical analysis and the multivariate analysis (Johnson, 1998).

RESULTS

Correlation analysis and principal component analysis revealed that only 14 variables were significant to describe xoconostle variability; cladode length, number of rows of areoles, number of areoles in central row, pericarpel length and width, fruit length, fruit diameter, fruit length/fruit diameter ratio, areoles density in the fruit, fruit receptacle depth, fruit weight, peel weight and pulp acidity. **Cluster analysis**. Fig. 1 presents the dendrogram resulting from the cluster analysis, it contains three cuasi-homogeneous groups; containing 10, 7 and 4 accessions, respectively. **Canonical discriminant analysis**. Two canonical roots (CR) explained 100% of variability; CR1 explained 87.55% and CR2 the remaining 12.45%. The following significant traits were associated to the first CR; areole density and number of areoles in the central row of the cladode, meanwhile; peel weight, fruit diameter, fruit weight and peel weight to the second. The results confirm human selection favored productive plants, larger fruits and acidic taste.

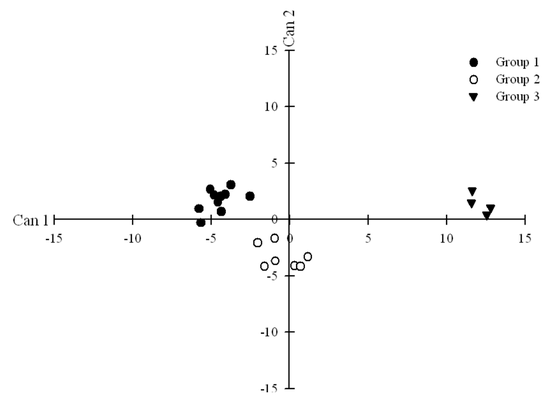


Fig. 2. Group dispersion as determined by cluster analysis based on the first two canonical roots.

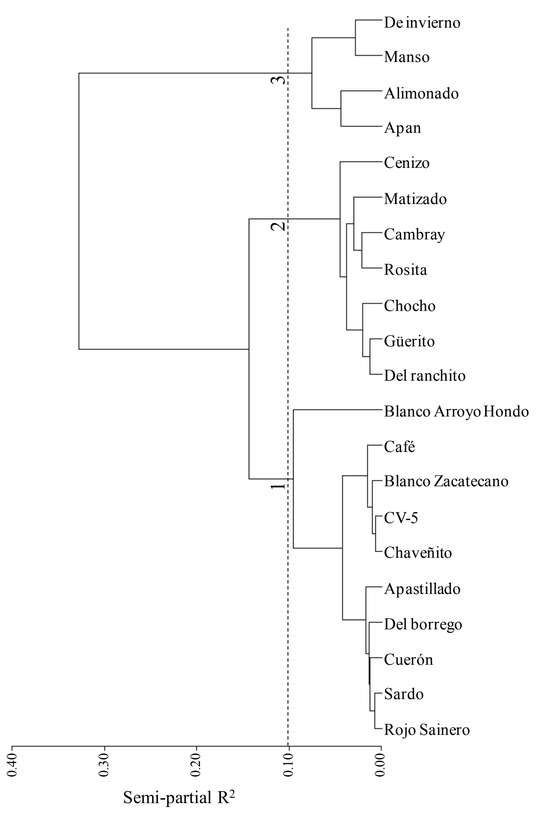


Fig. 1. Dendrogram of xoconostles (*Opuntia* spp.) from Central Mexico using the squared Euclidean distance and the Ward`s method.

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