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Criollo avocado of mexican race (*Persea americana* var. *drymifolia*): an underutilized species in horticulture

Abstract

Criollo avocado of Mexican race (CAMR) (*Persea americana* var. *drymifolia*) is native to Mexico. It is a species with great genetic variability due to open pollination and a high degree of polymorphism, which contributes to the unpredictable and highly variable phenotypic characteristics of its progeny. The fruits have been consumed in an ancestral way and are part of the culture and ethnobotanical knowledge of the Mexican peoples. CAMR's fruits have great nutraceutical and agro-industrial potential; however, they are currently underutilized and their main use is as rootstock for commercial varieties, mainly 'Hass' and 'Fuerte'. In addition, the thin peel and high perishability of the fruits are a limitation for their commercialization outside the production regions and a worrying fact is that with the introduction of other varieties, a large number of unexplored genotypes is being lost.In the above context, it is necessary to disseminate the horticultural, nutraceutical and agro-industrial potential of the CAMR among producers, marketers and consumers with the purpose of revaluation and conservation.

Keywords: anticancer compounds, genetic variability, loss of germplasm, nutraceuticals, rootstock, underutilized fruit

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Introduction

Criollo avocado of the Mexican race (CAMR) (*Persea americana* var. *Drymifolia*) is native to the high parts of central and southern Mexico, and from there it was dispersed towards the north of Mexico and part of Central America,[1] belongs to the *Lauraceae* Family and is part of the genetic base of commercial varieties that are currently marketed throughout the world as 'Hass', 'Fuerte' and their genetic variants.[2]

The CAMR is considered a hyper variable species because it presents a high degree of genetic polymorphism,[3] in addition, its form of reproduction is by open pollination[4] and its genome size is very large compared to other species (920 million base pairs),[2] which contributes to the fact that the phenotypic characteristics of its progeny are unpredictable and with a high degree of morphological polymorphism.[4] However, CAMR presents morphological and chemical characteristics of the species, which allows it to be differentiated from other races *Persea americana* var. *guatemalensis* and *Persea americana* var. *americana*.[5] In this context, the objective of this review is to describe the horticultural attributes and the main uses of CAMR, through the consultation and analysis of information available in articles and other sources published under strict scientific rigor.

The production of CAMR from pre-Hispanic times to the present day has been carried out in nature and in the backyard, with minimal agronomic work and without the application of agrochemicals, often subjected to high degrees of stress by biotic and abiotic factors,[5] this has allowed it to thrive in a large number of microclimates, thus contributing to the dispersal, hybridization and genetic variability of the species.[3] CAMR stands out from other avocado breeds for presenting agronomic characteristics desirable in horticulture, including resistance to cold and good adaptation to different types of soils.[6] It is worth mentioning that although some CAMR genotypes are susceptible to damage caused by insects (e.g., *Trioza anceps*, *Heilipus lauri*, and *Thysanoptera: Thripidae*) and pathogenic fungi (e.g., *Phytophthora cinnamomi*, *Colletotrichum gloeosporioides*, and *Sphaceloma perseae*) that cause damage to avocado crops, the damage is less than in commercial varieties such as'Hass' and 'Fuerte'.[7] In addition, there are resistant genotypes, Sánchez-Gonzales et al.[8] reported the resistance of CAMR rootstocks to *Phytophthora cinnamomi*; main pathogen that affect avocado production worldwide, causing root rot and secondary symptoms in the upper part of the plant, including dieback of branches, yellowing and wilting leaves, complete defoliation and death of the tree.

However, the characteristics of resistance and adaptation have led to the fact that currently the main use of CAMR is as rootstock for hybrid varieties that are marketed throughout the world, reducing the use of the fruit as a horticultural product for human consumption.[4] In addition, the mechanical characteristics of the fruit and its high perishability prevent it from being marketed outside the production regions.[9,10] This has caused producers to opt for the introduction of cultivars of higher value in the market such as 'Hass' and 'Fuerte' in orchards where CAMR was previously produced, thus causing a rapid disappearance of genotypes that have not been explored from a horticultural and nutritional point of view that could be of interest in the selection, improvement and creation of new varieties.[11]

The CAMR is an important part of the culture and identity of the communities where it is produced.[5] The tree is used in an integral way: the wood is used in the manufacture of furniture and crafts and the leaves are used as a condiment in traditional dishes and as infusions against pain and inflammation; however, there was no scientific evidence to support the benefits of consumption.[12] CAMR

leaves have a characteristic smell similar to anise and it is reported that they contain some compounds such as β-pinene, caryophyllene, estragole, hexadecanoic acid, heptacosane and α- tocopherol, some of them with antifungal, larvicidal, insecticidal and genotoxic activity.[13] In addition, they are a great source of phenolic compounds with antioxidant, anti-inflammatory and antimicrobial activity.[14]

On the other hand, CAMR fruits have been consumed since ancient times and represent a source of income for regional merchants.[5] They are botanically classified as berries and have a weight ranging from 188.14 to 1042.93 g, an average length and diameter of 11.77 of 8.43 cm respectively,[15] the most common fruit shapes are pyriform, oval and rounded.[10]

The pulp has a very characteristic consistency of avocado fruits, similar to butter due to its high lipid content (up to 23% of the total weight of the pulp) and the color presents yellowish tones in the center and green in the part. Exterior.[16] It has been reported to contain phenolic compounds and flavonoids in amounts comparable to those of the cultivar 'Hass', which have antioxidant, anti-inflammatory and antimicrobial activity.[12] The lipophilic portion of the pulp contains carotenoids (up to 7.83 mg eq. of β-carotene 100 g^{-1}f. w.) of which are known to have photoprotective activity and against chronic diseases such as prostate, liver and breast cancer.[16] In the same context, Méndez-Zúñiga et al.[16] reported a high content of monounsaturated and polyunsaturated fatty acids (up to 75.96 and 19.34%), commonly related to the proper functioning of the cardiovascular system.

The seed generally takes the shape of the fruit and can weigh up to 35 % of the total fruit and has anticancer[17] and antimicrobial[18] properties. In this context, Guzmán-Rodríguez et al.[19] and Flores-Álvarez et al.[20] reported the discovery of genes that code for the synthesis of defense peptides in the CAMR seed, which cause cell death by apoptosis in cancer cells that cause degenerative diseases such as breast cancer, colon cancer, and chronic myeloid leukemia.

The peel is thin (4 to 11% of the total weight of the fruit) with a characteristic smell and flavor of the species,[14] which resembles anise, generally they present colors with shades that go from purple to dark due to the presence of anthocyanins, pigments with high antioxidant activity.[20] It should be noted that, unlike other varieties, this type of fruit is traditionally consumed with the shell, taking advantage of the antioxidants it contains.[21] In the above context, the CAMR presents great nutraceutical and agro-industrial potential that could be used by producers, food and pharmaceutical industries for different uses in which little has been done.

Conclusion

Genetic, morphological and phytochemical variability, as well as the capacity for resistance and adaptation, position CAMR as a genetic heritage that must be conserved. Is evident the need for a revaluation of CAMR fruits as a source of secondary metabolites with nutraceutical, antimicrobial and anticancer properties that allow progress in actions for the conservation of CAMR germplasm threatened with the destruction of its natural habitat and introduction of commercial varieties

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Conflicts of interest

Authors declare no conflict of interest exists.

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