

Brazil cherry (*Eugenia dombeyi*) – an underutilized fruit species of the American tropics

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Brazil cherry (*Eugenia dombeyi*) – an underutilized fruit species of the American tropics.

Abstract – Introduction. Brazil cherry or grumichama is a little-known, underutilized fruit species of the Myrtaceae family; this tree forms part of CATIE's field collection of tropical fruits. It is native to southern Brazil and cultivated on a small scale in Brazil, Paraguay, Florida and Hawaii. **Materials and methods.** Fruit traits were assessed among 12 seedling trees of the same source of origin, and the potential of fresh fruit and derived products was surveyed among employees and students. **Results and discussion.** Fruit traits (total soluble solids, fruit weight, fruit diameter, flesh weight, seed weight and number of seeds per fruit) differed significantly among the 12 trees. Survey respondents rated derived products such as yellow jam, (red grumichama + citrus) jam and (red grumichama + mocha) jam higher than fresh fruit, red jam, grumichama wine and juice. **Conclusion.** Grown in home gardens as an ornamental or as a fruit-bearing tree, or planted as a living fence or windbreak, this fruit crop merits a place in tropical and subtropical settings due to the attractiveness of the tree, its foliage and bloom, its tasty fruit, its contribution to agricultural biodiversity, and the possibility of generating value-added products at the farm, household or community level. For fruit production, vegetative propagation is recommended to retain high quality traits.

Costa Rica / *Eugenia dombeyi* / fruits / fruit products / organoleptic analysis / quantitative analysis / qualitative analysis

Le cerisier du Brésil (*Eugenia dombeyi*) – Une espèce fruitière sous-utilisée de l'Amérique tropicale.

Résumé – Introduction. Le cerisier du Brésil ou *grumichama* est une espèce fruitière peu connue et sous-utilisée de la famille des myrtacées; cet arbre fait partie de la collection de fruitiers tropicaux gérée au champ par le CATIE. Il est originaire du sud du Brésil et est cultivé sur une petite échelle au Brésil, au Paraguay, en Floride et à Hawaï. **Matériel et méthodes.** Les caractéristiques des fruits de *E. dombeyi* ont été évaluées pour 12 arbres issus de semis de même origine et le potentiel des fruits frais et de leurs produits dérivés a été étudié auprès d'employés et d'étudiants du CATIE. **Résultats et discussion.** Les caractéristiques des fruits (solides solubles totaux, poids du fruit, diamètre du fruit, poids de chair, poids des graines, et nombre de graines par fruit) ont différé sensiblement entre les 12 arbres. Les participants au sondage ont mieux noté les produits dérivés du fruit comme la confiture jaune, la confiture de (*grumichama* rouge + agrumes) et la confiture (*grumichama* rouge + moka), que les fruits frais, la confiture rouge, le vin et le jus de *grumichama*. **Conclusion.** Cultivée dans les jardins familiaux comme plante ornementale ou comme arbre fruitier, ou plantée comme haie vive ou brise-vent, cette espèce fruitière mériterait d'avoir sa place dans les milieux tropicaux et subtropicaux en raison de l'attrait de l'arbre, de son feuillage et de sa floraison, de son fruit savoureux, de sa contribution à la biodiversité agricole, et de la possibilité qu'il offre de générer des produits à valeur ajoutée à l'agriculteur, sa famille ou sa communauté. Pour la production de fruits, on recommandera de privilégier la multiplication végétative afin de conserver les caractéristiques de haute qualité.

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Costa Rica / *Eugenia dombeyi* / fruits / produit à base de fruits / analyse organoleptique / analyse quantitative / analyse qualitative

Table I.

Rainfall (mm) in Cabiria (Costa Rica), CATIE's experimental farm, during the first 6 months in 2006 and 2007.

Year	January	February	March	April	May	June	Total
2006	584.3	177.8	223.5	85.3	156	323.6	1550.5
2007	139.9	55.7	131.3	54.2	326.2	212.5	919.8

1. Introduction

The Tropical Agricultural Research and Higher Education Center (CATIE) in Turrialba, Costa Rica, maintains globally important collections of genetic resources of coffee, cacao, diverse fruit species and vegetables. Among fruit crops, the genus *Eugenia* of the Myrtaceae family comprises several interesting underutilized species suitable as ornamental trees that can also provide edible fruit, thus combining beauty with utility in home gardens.

The Brazil cherry or grumichama (*Eugenia dombeyi*) is an ornamental tree with attractive glossy and compact foliage and abundant white flowers during full bloom. It is native to and grows wild in the coastal regions of southern Brazil (Paraná and Santa Catarina); it is cultivated on a small scale in the state of Rio de Janeiro and in Paraguay [1]. The tree is adapted to subtropical humid and tropical wet climates and requires well-drained, medium to deep soils with moderate to high soil fertility¹. The fruit, consumed fresh as food and in beverages, provides a good source of vitamins and minerals; leaves and stems have medicinal properties [1] with applications for the blood and genitourinary systems, while the entire plant has environmental uses as a living fence or ornamental tree¹. Brazil cherry generally is grown from seed and starts producing in the fourth to fifth year, but it can be propagated through grafting or cloning by air-layering and cuttings, which considerably shortens the juvenile stage of the tree.

¹ Ecocrop Data Sheet - *Eugenia dombeyi*, FAO, available at <http://ecocrop.fao.org/ecocrop/srv/en/dataSheet?id=5967> [verified 24 March 2010].

At CATIE, flowering of Brazil cherry usually occurs from March to April but can extend up to June if the onset of the rains is delayed, as it was in 2007 when our experiment was conducted (*table I*). Heavy and consistent rainfall during the first three months of 2006 triggered early and concentrated flowering from the end of March to the beginning of April, while sparse rainfall during the first four months in 2007 delayed flowering. Heavy rainfall in May 2007 induced flowering, with a peak occurring at the beginning of June. Supplemental irrigation is recommended for high fruit production when annual rainfall is below 1778 mm². Optimal annual rainfall ranges from (1200 to 2500) mm¹. Flowering is reported to occur during April in Florida [1], from May to July in Hawaii [2], and from November to February in Brazil [3]. Fruit development occurs at a fast pace. Fruit reaches maturity within four weeks after flowering, and the harvest season covers a brief two-week period. The fruits are oblate, the size of a cherry, and bear persistent sepals at the apex (*figure 1*). The red pulp of dark purple to black fruit or white pulp of yellow fruit is juicy and has a pleasant taste and aromatic flavor that resembles a true sweet or subacid cherry with a hint of aromatic resin [1]. As early as 1791, Brazil cherry was introduced into Hawaii [1], where it was recently promoted under the 12 Trees Project [2]. Brazil cherry is also well-known by hobby gardeners in Australia and New Zealand and seedlings are offered on the Internet. The authors found trees for sale at a farmers' market in

² Love K., Grumichama, available at <http://www.hawaiiifruit.net/grumichama.htm> [verified 24 March 2010].

Shanhua, Taiwan (figure 1). Plants propagated vegetatively from cuttings are sold at this market for US\$37.70 (NT\$ 1,200) per tree and seedling trees at US\$15.70 (NT\$ 500) (figure 1).

In Hawaii, fresh fruit packaged in plastic blister packs is sold to hotel and restaurant chefs at US\$7 and to wholesale and grocery store buyers at US\$4.50 per pound [2]. Comparing the cost of production of 12 fruit types in Hawaii, the gross margin of Brazil cherry ranked third after fig and loquat [2]; thus, the tree is of commercial interest for small-scale production where market links have been established.

Brazil cherry forms part of CATIE's field collection of tropical fruits, but this tree is unknown to most employees and students undertaking their Masters and PhD studies at this institution. Our study was undertaken to analyze fruit traits and raise awareness of the potential of this underutilized crop.

2. Materials and methods

2.1. Experimental site, materials and survey

Fruit samples of 1–2 kg each were harvested in July 2007 from 12 mature seed-propagated trees selected from a total of 26 trees, based on comparable fruit load. All 26 trees were derived as seedlings from the same source of origin introduced into CATIE's field genebank as accession no. 1298 from Belo Horizonte, Minas Gerais, Brazil, on January 20, 1950. The 26 seedling trees were established in 1980 in Cabiria, CATIE's experimental fields, situated at an altitude of 602 m above sea level at 9.38° N lat. and 83.38° E long. A subset of 25 fruits was selected at random from the harvested samples and assessed with regard to fruit traits (total soluble solids, fruit weight, fruit diameter, flesh weight, number of seeds per fruit and seed weight). Total soluble solids (TSS) of fruits were recorded using a hand-held refractometer. The remaining fruit was processed into juice, red and yellow jam derived from red and yellow fruit, (red grumichama



+ citrus) jam, (red grumichama + mocha) jam, and cherry wine.

A survey was undertaken among CATIE employees of the Plant Genetic Resources and Biotechnology group ($n = 16$) and CATIE MSc students from Central and South America ($n = 7$) in the 2007 Plant Genetic Resources course on their knowledge of the fruit and appreciation of fresh fruit and derived products.

The following scale was used to rate fresh fruit and derived products:

1: strongly disliked it; 2: less than average; 3: average/take it or leave it; 4: enjoyed it/would eat it again; 5: very much liked it/would seek it out.

2.2. Statistical analysis

The quantitative fruit trait data were subjected to an analysis of variance (ANOVA)

Figure 1. Brazil cherry trees propagated through cuttings or raised as seedlings for sale at a farmers' market in Shanhua, Taiwan. Inserted photo shows flowers (bottom) and ripe fruits (top) with persistent sepals at the apex. (Figure in color online.)

Table II.

Mean, minimum, maximum and standard deviation of fruit traits among 12 Brazil cherry trees (*Eugenia dombeyi*) raised from seedlings.

Value	Total soluble solids (%)	Fruit weight (g)	Fruit diameter (mm)	Flesh weight (g)	Seed weight (g)	Number of seeds per fruit	[Flesh weight / seed weight] ratio
Mean	11.8	4.5	19.6	3.7	0.8	4.0	5.0
Minimum	10.2	3.1	17.1	2.6	0.5	1.9	3.2
Maximum	13.1	6.1	21.7	5.4	1.3	8.5	7.8
Standard deviation	0.93	1.01	1.55	0.91	0.23	2.22	1.44

according to Steel and Torrie [4]. Using NTSYS-pc version 2.20, the means for each tree were standardized and the distance coefficients calculated using average taxonomic distances [5]. A cluster analysis was performed on Euclidean distance with the NTSYS-pc SAHN program and a dendrogram was built using the group average method, known as the Unweighted Pair Group Method Average (UPGMA). Fisher's exact test was employed to test the independence of the rating of the two respondent groups. Thereafter, the χ^2 test for fixed ratios was performed to test if observed ratios deviated significantly from expected ratios [4].

Figure 2. Dendrogram of 12 Brazil cherry trees (*Eugenia dombeyi*) constructed from UPGMA analysis, based on taxonomic Euclidean distance coefficients.

3. Results and discussion

In our samples, fruit traits varied considerably among the 12 Brazil cherry trees sam-

pled (table II). Total soluble solids ranged from 10.2% to 13.1%, with a mean value of 11.8%; fruit weight ranged from (3.1 to 6.1) g with a mean value of 4.5 g; fruit diameter was between (17.1 and 21.7) mm with a mean value of 19.6 mm; flesh weight ranged from (2.6 to 5.4) g with a mean of 3.7 g; seed weight was between (0.5 and 1.3) g with a mean value of 0.8 g; the number of seeds per fruit presented considerable variation, ranging from 1.9 to 8.5 with a mean value of 4.0; the [flesh weight / seed weight] ratio varied from 3.2 to 7.8 with a mean value of 5.0.

Large-sized, heavy fruits with high total soluble solids, a high [flesh weight / seed weight] ratio and low seed number per fruit are generally preferred for fresh consumption. Given the high variation in fruit quality traits among the sampled trees, propagation by seed apparently is not the best method. The very high number of seeds in fruit harvested from some seedling trees is a clear indication that a selection process is necessary to identify trees that can produce fruit with an acceptable seed number in the range of one to three seeds [1, 2]. It would be highly desirable to select and propagate candidate trees vegetatively through grafting, air-layering or cuttings. The cluster analysis separated the 12 seedling trees into five clusters (figure 2). The trees numbered 2 and 19 formed cluster (II). Fruits harvested from these two trees presented the highest fruit and flesh weight, the largest fruit diameter, and the best [flesh weight / seed weight] ratio and are, therefore, the ideal candidates for vegetative propagation.

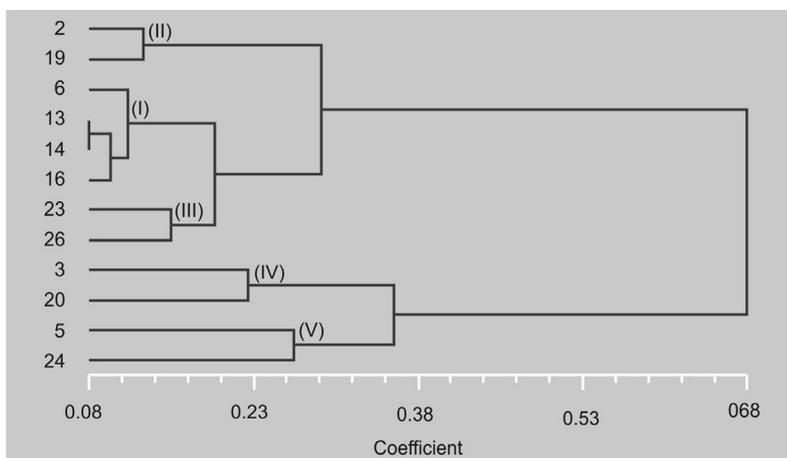


Table III.

Relative frequency of ratings concerning different products of Brazil cherry fruits as given by two groups of respondents: employees and MSc students (sample size $n = 23$). For all products and ratings, the test percent is 33.00.

Products	Rating	Frequency	Percent	Statistical parameters	
				χ^2 test	<i>P</i>
Fresh fruit	5	3	13.04	$\chi^2 = 10.8938$	<i>P</i> = 0.0043**
	4	15	65.22		
	3	5	21.74		
Juice	5	8	34.78	$\chi^2 = 1.6712$	<i>P</i> = 0.4336 ns
	4	10	43.48		
	3	5	21.74		
Red jam	5	8	34.78	$\chi^2 = 7.9953$	<i>P</i> = 0.0184*
	4	13	56.52		
	3	2	8.70		
Yellow jam	5	17	73.91	$\chi^2 = 17.4815$	<i>P</i> = 0.0002**
	4	4	17.39		
	3	2	8.70		
(Red grumichama + citrus) jam	5	14	60.87	$\chi^2 = 7.9953$	<i>P</i> = 0.0184*
	4	5	21.74		
	3	4	17.39		
(Red grumichama + mocha) jam ^a	5	11 (11/0)	47.83	-	-
	4	7 (4/3)	30.43		
	3	5 (1/4)	21.74		
Brazil cherry wine	5	7	30.43	$\chi^2 = 4.3062$	<i>P</i> = 0.1161 ns
	4	12	52.17		
	3	4	17.39		

^a Divergence between the ratings of the two respondent groups is given in brackets.

Large-sized fruits tend to be very soft and due to the thin skin are delicate to handle during harvesting, packaging and marketing as fresh fruit. Retaining the stem when harvesting the fruit is difficult but improves shelf life and helps prevent desiccation and fruit decay. Trees among the CATIE collection that produced the smallest fruit had increased fruit firmness and better postharvest handling properties but were less tasty and not appropriate for fresh consumption.

The survey showed that both surveyed groups (CATIE employees and MSc students) used only three categories (3, 4 and

5) out of the five available to rate the different Brazil cherry products, meaning that none of the respondents gave a very poor (1: strongly disliked it) or poor (2: less than average) rating for any of the products. The hypothesis of independence between respondent groups across rating categories was tested with Fisher's exact test. The results were not significant, indicating that the distribution ratios of ratings were independent of the respondent grouping, and *vice versa*. Hence, the relative frequency of ratings of both respondent groups was combined (table III). Only for (red grumichama + mocha) jam was there divergence

between the two respondent groups: employees used three categories (3, 4, 5) while MSc students used only two (3, 4). For ease of reference, the rating of the two groups was combined (*table III*).

Out of 23 respondents only three (13%) had known the fruit before (data not given). Yellow jam from yellow fruits, (red grumichama + citrus) jam, and (red grumichama + mocha) jam were the most preferred products and received the highest ranking (5: very much liked it/would seek it out) from the majority of respondents, with a support rating of 73.9%, 60.9%, and 47.8%, respectively (*table III*). For yellow jam ($P = 0.0002$) and (red grumichama + citrus) jam ($P = 0.0184$), the χ^2 test for fixed ratios indicated that the observed ratios deviated significantly from the expected ratios. Fresh fruit (65.2%), red jam (56.5%), Brazil cherry wine (52.2%) and juice (43.5%) received a rating of 4 (enjoyed it/would eat it again) from the majority of respondents. For fresh fruit ($P = 0.0043$) and red jam ($P = 0.0184$) the χ^2 test for fixed ratios indicated that the observed ratios deviated significantly from the expected ratios, while this was not the case for Brazil cherry wine and juice. Most respondents were of the opinion that, although Brazil cherry fruit is hardly known, it has good market potential, especially as processed food in the form of jam.

Fresh fruit clearly was not the first choice of respondents; many expressed concern that the soft skin of Brazil cherries would hamper successful marketing as fresh produce. Derived products in the form of jam were highly appreciated by the respondents to the survey and it was recommended to explore their market potential.

4. Conclusion

Grown in home gardens as an ornamental or fruit-bearing tree, or planted as a living

fence or windbreak, this fruit crop merits a place in tropical and subtropical settings due to the attractiveness of the tree, its foliage and bloom, the tasty fruit, its contribution to agricultural biodiversity, and the possibility of generating value-added products at the farm, household or community level. If the main objective is fruit production and consumption, it is recommended that trees with outstanding fruit quality traits be chosen and that they be propagated vegetatively, given the strong segregation observed among seed-propagated trees in this study.

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El cerezo de Brasil (*Eugenia dombeyi*) – Una especie frutera poco utilizada de la parte tropical de América.

Resumen - Introducción. El cerezo de Brasil o *grumichama* es una especie frutal poco conocida y poco utilizada de la familia de las mirtáceas. Éste árbol forma parte de la colección de árboles frutales tropicales gestionados en el campo por el CATIE. Es originario del sur de Brasil y cultivado en una pequeña escala en Brasil, Paraguay, Florida y Hawái. **Material y métodos.** Las características de los frutos de *E. dombeyi* se evaluaron en 12 árboles pertenecientes de siembra del mismo origen, y empleados y estudiantes del CATIE estudiaron el potencial de frutos frescos y de sus productos derivados. **Resultados y discusión.** Las características de los frutos (sólidos solubles, peso del fruto, diámetro del fruto, peso de la piel, peso de las semillas y número de semillas por fruto) se diferenciaron sensiblemente entre los 12 árboles. Los participantes al sondeo calificaron mejor los productos derivados del fruto como la mermelada amarilla, la mermelada de (*grumichama* roja + cítricos) y la mermelada (*grumichama* roja + moca), que los frutos frescos, la mermelada roja, el vino y el jugo de *grumichama*. **Conclusión.** Cultivada en los jardines familiares como planta ornamental o como árbol frutal, o plantada como cerco vivo o cortavientos, esta especie frutal merecería tener su lugar en los medios tropicales y subtropicales, dado al atractivo del árbol, de su follaje y de su floración, de su sabroso fruto, de su contribución a la biodiversidad agrícola, y a la posibilidad que brinda de generar productos de valor añadido al agricultor, a su familia o a su comunidad. Para la producción de frutos, se recomendará privilegiar la multiplicación vegetativa con el fin de conservar las características de alta calidad.

Costa Rica / *Eugenia dombeyi* / frutas / productos derivados de las frutas / análisis organoléptico / análisis cuantitativo / análisis cualitativo

