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Growth and quality of Brazilian accessions of *Capsicum chinense* fruits

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Abstract

Total fresh and dry weight of *Capsicum chinense* fruit accessions were inversely correlated with accumulation of dry matter, and fruits with a higher percentage of dry matter accumulated proportionally more total soluble solids. Based on regression analysis, a 1% increase in fruit dry weight was associated with a 0.28% improvement in total soluble content, up to a maximum total soluble solid content of 10.25%. Regardless of shape, larger fruits had thicker pericarps, and were therefore more suitable for open air fresh markets. Smaller fruits had thinner pericarps and higher concentrations of total soluble solids and were more appropriate for dehydration and paprika production. Dry fruits with color intensities greater than 200 ASTA units, as required for paprika production, were found in 18.4% of the analyzed accessions. A large number of accessions, close to 27%, had total capsaicinoid concentrations less than or equal to 1.9 mg g^{-1} dry weight, and can be considered as sweet or light pungent fruits. A small percentage of accessions (2.5%) were classified as extremely hot fruits.

Keywords: Dry matter; Total soluble solids; Color intensity; Capsaicinoids

1. Introduction

The genus *Capsicum* comprises a highly diverse group of sweet and hot peppers that originated from the tropics of the American continent. Five species are commercially cultivated, *Capsicum annuum*, *Capsicum frutescens*, *Capsicum baccatum*, *Capsicum pubescens* and *Capsicum chinense* (Pickersgill, 1997). *C. annuum* is the most diverse and cultivated pepper, and is comprised of both sweet and hot peppers varieties, including sweet bell peppers, paprika and Mexican chile peppers (jalapeños). In Brazil, however, *C. baccatum* and *C. chinense* are the predominant species for commercial hot peppers, since these species are well adapted to equatorial and tropical climate conditions and have unique flavors for fresh consumption. However, the fruit quality traits for most of the cultivated varieties of these species produced in Brazil are still undetermined.

The species *C. chinense* was originally found in the Amazon basin, but is commercially grown throughout southern and northern Brazil, due to its adaptability to different soil and local climates, and its popular citrus-like aroma. Fruits from this species show an enormous variability in size and shape, and in the different intensities of yellow, orange or red when ripe. The pungency of the fruits is due to the accumulation of capsaicinoids and is one of the most important quality traits considered by the spice industry (Maillard et al., 1997). In addition, capsaicinoids exhibit antioxidant activity and have been demonstrated to protect linoleic acid against free radical attack (Rosa et al., 2002). The high content of carotenoids in ripe pepper fruits make them important sources of these essential nutrients in the human diet (Marín et al., 2004). During ripening of red *C. annuum* fruits, there is intense synthesis of carotenoid pigments, mainly capsanthin, capsorubin and cryptocapsin (Camara, 1980). The accumulation of these pigments accounts for the fruit's intensity of redness and is an important quality trait for the food colorants, paprika and oleosins (Mínguez-Mosquera et al., 2000). Regardless of the importance of *C. chinense* in Brazil, little is known about the fruit's growth, and the variability in capsaicinoid concentration and color intensity in the accessions collected throughout the country over the past three decades.

According to Bosland (1993), the quality of dry fruit products, like red chile and paprika, is based on their redness of color and pungency level, which is usually obtained from *C. annuum* peppers. However, the content of dry weight and soluble solids are also essential for higher yields for the

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industry that processes dry pepper products. Despite the popularity of *C. chinense* among the population in Brazil, the potential use of this pepper for industrial chile or paprika production has not been analyzed yet.

The Horticultural Germplasm Bank (BGH) located at the Federal University of Vicosa stores one of the largest collection of *Capsicum* spp. in Brazil. From more than 100 accessions of *C. chinense*, 49 were selected for this study. Accessions were chosen for diversity of fruit color, size and shape. Thus, this work was undertaken to determine the variability of important fruit traits for fresh market and processing use of *C. chinense* accessions.

2. Materials and methods

Forty-nine accessions of *C. chinense* from the Germplasm Bank (BGH) at the Federal University of Viçosa were planted in the field and covered with white fabric for two consecutive generations to ensure self-pollination. Afterwards, the plants were grown at the garden field in Viçosa (642 m altitude, 20°45′S latitude and 42°51′W longitude), distributed in random block design, with three replicates containing three plants each, spaced 0.5 m within the row and 1.0 m between rows.

Seeds of the accessions used in this experiment are available at Federal University of Viçosa (BGH/UFV). Shape and color of vine ripened fruits were evaluated according to the descriptors for *Capsicum* spp. recommended by IPGRI (1995) (Table 1). Total fresh fruit weight and pericarp thickness were evaluated in vine ripened fruits. The fresh fruits were cut in half and the thickness of the pericarp was measured at the equatorial portion of the fruit using a vernier caliper. Fruits were then dried at 65 °C until constant weight for determining total and percent dry matter. The juice from fresh pressed fruit pericarp was used to determine total soluble solids at 25 °C with a Atago 3T bench refractometer.

Washed whole-sliced seed-bearing fruits, without the peduncle were oven dried at 65 °C and then finely ground to produce the paprika used for extractable color analysis as described by ASTA (1997). The same dry samples were used to evaluate the content of capsaicin using a modification of the method described by Maillard et al. (1997). Fifty milligrams of sample were mixed with 5 ml of 60% methanol. The mixture was sonicated for 15 min, followed by centrifugation at 4000 rpm for 15 min. The supernatant was filtered throughout a 0.45 μm pore size filter and analyzed with a Hitachi L4500 HPLC system, equipped with a C18 Hypersil analytical column (250 mm × 4.6 mm and particle size diameter of 5 μm). Capsaicin separation was effected using a running buffer comprised of methanol–water–acetic acid (70:29:1, v/v/v) at a flow of 1 ml/min at 20 °C and detection at 280 nm. The standard solution for the identification and quantification of capsaicinoids was composed of pure capsaicin and dihydrocapsaicin (Sigma, USA).

Five ripe fruits were analyzed from each of the three experimental random blocks. Pearson's correlation coefficients were determined to establish relationships among fruit traits using the SAEG/UFV (Brazil) program.

Table 1
Identification of *Capsicum chinense* accessions, fruit shape and color from the Viçosa Federal University/Germplasm Bank (BGH/UFV)

ID number	Shape	Color
05	4	Y
06	2	R
07	2	R
09	5	R
11	5	O
14	5	Y
16	5	Y
17	1	Y
18	1	Y
19	5	Y
22	3	O
23	3	R
26	2	R
27	5	R
30	4	O
32	5	O
34	4	Y
39	1	O
40	3	R
44	3	Y
45	1	O
46	5	Y
51	4	Y
53	4	Y
54	1	R
55	1	O
56	1	R
57	3	R
59	5	R
67	1	O
70	3	R
71	5	R
72	3	Y
76	1	Y
78	3	O
79	1	Y
82	1	R
83	1	R
84	4	R
85	4	R
86	1	R
87	2	Y
90	3	Y
93	1	O
94	1	R
95	5	R
98	5	O
100	2	Y
101	2	Y

Fruit shape: 1 = elongate; 2 = almost round; 3 = triangular; 4 = campanulate; 5 = blocky. Fruit color: Y = yellow; O = orange; R = red.

3. Results and discussion

When fruit fresh weight was correlated with the percentage of dry weight accumulated by the fruit, a linear inverse correlation ($r = -0.77$) was observed (Fig. 1A). Thus, the estimated percentage of accumulated dry matter varied from 4.57 to 16.20% for the largest fruit of 19.15 g fresh weight to 0.99 g for the smallest fruit, respectively. Similarly, fruits with