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Comparison of fruit quality parameters among white, pink and red pulp pummelos of Assam

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ABSTRACT
The present study is a part of an investigation undertaken during 2014-16 to study the variation in pummelo fruits of Assam. Twenty-four bearing plants of similar age were selected randomly for the study. The selected pummelos were grouped into three different categories based on pulp colour. Comparison of quality parameters viz., juice pH, TSS, acidity, reducing sugar, non reducing sugar, total sugar, TSS acid recorded significant variation. The highest average juice pH of 3.78 was recorded in red type, which was followed by white type (3.52) and the lowest was recorded in pink pummelo (3.49). Average titrable acidity was recorded to be the lowest in red type (0.87%) indicating higher sweetness followed by white type (1.03%) and pink type (1.08%), respectively. The present study revealed that the red pulp pummelos are superior compared to pink and white pulp in terms of quality parameters and the variation among three pummelo types might be attributed to genetic factor and varying environmental conditions under which the genotypes has been grown. Hence, these variations recorded are the important sources for further genetic improvement in pummelo and other citrus species.
Key Words: *Pummelo, accessions, acidity, juice pH, total sugar, Citrus grandis*

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INTRODUCTION

Pummelo or shaddock (*Citrus grandis* (L.) Osbeck, synonyms *Citrus maxima* (J. Burm.) has been regarded as an ancient species of the genus *Citrus* (Scora, 1975). It is an underutilized citrus fruit of Northeast region and India as a whole and mostly grown as backyard crop in homestead garden. It is mono embryonic in nature and highly cross pollinated. Citrus fruits are recognized as an important component of the human diet, providing a variety of constituents important to human nutrition including vitamin C, folic acid, potassium, flavonoids, coumarins, pectin and dietary fibres. The North-eastern region of India is rich treasure of various citrus species with vast reservoir of diversity in wild, semi wild form with least care (Hazarika, 2012). Fresh red pummelo juice is an excellent source of antioxidant compounds and exhibited great efficiency in scavenging different forms of free radicals including DPPH, superoxide anion, and hydrogen peroxide radicals (Tsai *et al.*, 2007). Being a cross pollinated crop, there is a tremendous amount of variability within the species with which the breeder can work, that provide even a wider selection of characters (Soost and Roose, 1996). Keeping these in view, the present study was carried out in order to determine the existing variability in terms of quality parameters among pummelo types of Assam.

MATERIALS AND METHODS

The experiment was conducted in Assam Agricultural University, Assam during 2015-2016. Four healthy pummelo trees between 10 to 20 years of age were selected in each district comprising of twenty four numbers of trees in six districts representing six agro-climatic zones of Assam. The fruits were harvested at optimum maturity stage i.e. 200 days after fruit set. Five fruits from each plant were collected, washed, peeled and juice vesicles were separated from the segments for extraction of juice using power operated juicer. Extracted juice was evaluated for various quality characters. *viz.,* total soluble solids, ascorbic acid, juice pH, titrable acidity, reducing sugar, non reducing sugar, total sugar and TSS acid ratio. All the

twenty-four pummelo accessions were statistically analyzed and the mean value of white, pink and red pummelo accessions was compared. TSS of the fruit juice samples was determined by Atago Digital Refractometer (Japan) and the result was expressed in °Brix (A.O.A.C., 1984). pH of fruit juice was determined by digital pH meter cyberscan 510 and average was recorded. Titrable acidity was estimated by adopting the standard method of Association of Analytical Chemists (A.O.A.C., 1980). Ascorbic acid content was determined by using 2,6-dichlorophenolindophenol dye method (Freed, 1966). TSS-acid ratio was calculated by dividing TSS by acidity. Total, reducing and non reducing sugar was estimated following the Fehling's copper reduction method as described by Usha *et al.* (2015).

RESULT AND DISCUSSION

All the twenty-four pummelo accessions collected from six different locations of Assam were broadly grouped into three categories viz., white (six), pink (eleven) and red (eight) based on pulp colour and comparison was done for quality parameters.

Fruit juice characteristics such as pH, titrable acidity, total soluble solids (TSS), sugar, TSS-acid ratio and ascorbic acid are the important quality parameters which determine the overall acceptability of fruits by the consumers. Wide variability was observed among the three pummelo types (Table 1).

Significant variation was observed among three types of pummleo for juice pH. The highest average juice pH of 3.78 was recorded in red type, which was followed by white type (3.52) and the lowest was recorded in pink pummelo (3.49). The variation might be due to the acid content of juices of different pummelo genotypes. Average titrable acidity was recorded to be the lowest in red type (0.87%) indicating higher sweetness followed by white type (1.03%) and pink type (1.08%), respectively. The total soluble solid was recorded highest in red pulp (10.34 °Brix) followed by pink type (9.69 °Brix) and lowest was recorded in white type (9.12 °Brix). Singh and Sheo Govind (1999) reported similar variation in TSS among different pummelo collections from north east India. Reducing sugar per cent was recorded to be highest in red type pummelo with 5.06% followed by pink type (4.53%) and the lowest was recorded in white pulp (4.11%).

Non reducing sugar (sucrose) percentage was recorded to be the highest in red type pummelo with an average of 3.77% followed by pink type (3.45%) and the lowest of 3.27% in white type pummelo. The highest total sugar was recorded to be 8.83% in red type followed by 7.98% in pink type and least by white type (7.37%) indicating that the red pummelos are sweeter compared to pink and white type. The present study is in conformity with the previous reports of Roy *et al.* (2014) and Zhang *et al.* (2014) who recorded similar variation among pummelos.

The highest TSS acid ratio of 12.41 was recorded in red type pummelo followed by pink type (9.38) and the least was recorded in white type with an average of 8.95. Wide variation in TSS acid ratio indicated that red pummelos were superior to the pink and white type in terms of fruit quality. The present finding is fairly consistent with those reported by Roy *et al.* (2014) and Mitra *et al.* (2011) in pummelo fruits of West Bengal. Variation was observed among different pummelo types with respect to TSS acid ratio. The highest ascorbic acid content of 66.57 mg/100ml was recorded in white type pummelo followed by red type (57.95 mg/100ml) and pink type (53.68 mg/100ml). The observation was fairly consistent with the earlier report of Chaiwong and Theppakorn (2010) and Roy *et al.* (2014) who recorded an average ascorbic acid content of 52.25 mg/100ml and 48.89 mg/100ml in pummelo fruits of Thailand and West Bengal, respectively. The variation in ascorbic acid content among accessions might be due to genetic factor, position and maturity stage of the harvested fruits, soil nutrient status and environmental variation. Harris (1975) reported that the fruits exposed to maximum sunlight contain higher amount of ascorbic acid than those inside the canopy or under shaded condition.

Table 1. Comparison of quality parameters among white, pink and red pulp pummelos

Pummelo types	Juice pH	TSS (°Brix)	Titrable acidity (%)	Reducing sugar (%)	Non reducing sugar (%)	Total sugar (%)	TSS/acid ratio	Ascorbic acid (mg/100ml)
White	3.52	9.12	1.03	4.11	3.27	7.38	8.85	66.57
Pink	3.49	9.69	1.08	4.53	3.45	7.98	8.97	53.68
Red	3.78	10.34	0.87	5.06	3.77	8.83	12.41	57.95
Mean	3.60	9.72	0.99	4.57	3.50	8.06	10.08	59.40

* Data are mean of five white, eleven pink and eight red pummelo accessions

CONCLUSION

The present study revealed that the red pulp pummelos are superior to pink and white pulp with respect to quality parameters such as TSS, titrable acidity, total sugar content, and TSS acid ratio and the variation

among three pummelo types might be attributed to genetic factor and varying environmental conditions under which the genotypes has been grown.

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