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RESEARCH PAPER

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Standardization of recipe and juice extraction method for preparation of ready-to-serve beverage from custard apple (*Annona squamosa* L.)

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● ABSTRACT ●

Custard apple (*Annona squamosa* L.) known as sitaphal is delicious and nutritionally valuable fruit grown at higher elevations (2000 MSL) in tropic. It is highly perishable in nature and available for short period from 1st week of October to third week of November. Being perishable with poor self life it needs quick disposal. Further, short duration of its availability as well as a good harvest during peak season creates a glut in the market. Consequently the growers are compelled to self their produce at low price, which causes economic losses to them. Considering the various point an experiment was conducted for value addition with custard apple fruit in different combinations and was observed that hot method + 15% blended juice of custard apple and lime (3:2) + 15% TSS + 0.2% acidity was found best with respect to colour (off white), taste, over-all acceptance and ascorbic acid.

KEY WORDS : Custard apple RTS, Method, Recipe, Juice extraction

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● INTRODUCTION ●

Custard apple (*Annona squamosa* L.) belong to the family *Anonaceae* are acclimatized to tropical climate where they can withstand heat and drought conditions. It is one of the delicious fruits relished by many for table purposes. Pleasant flavour, mild aroma and sweet taste have a universal acceptance. In Rajasthan it is naturally grown in the forests and on the marginal lands. Custard apple is the main source of income for the tribal people of south Rajasthan, especially, Udaipur, Dungarpur, Banswara, Chittoregarh and Sirohi districts. Annona fruits are very perishable and have a short post harvest life, therefore, they require efficient value addition techniques. Ripe fruits can be stored only for 2-3 days without decay. It is observed that more than 75 % of fruits produced in tribal areas are wasted due to inefficient storage and value addition techniques and short self life of fruits (personnel observation). During the glut period, tribal sold their produce at thrown away prices of Rs. 1-2 per kg. It is nutritionally valuable consist of 40% pulp having 26.4 per cent TSS, 5 per cent tannin, carbohydrate, vitamin A and ascorbic acid. Further, the value addition of custard apple fruits become necessary to minimize the glut in the market due to short time availability need quick disposal. However, fruit processing industry is dependent only on a few fruit like mango, pineapple and citrus for RTS. However, Ready-To-Serve is a fruit beverage that contains at least 10% fruit juice, 10% total soluble solids and 0.3 per cent acidity is rich in essential minerals, vitamins and other nutritive constituent. It is liked and appreciated by all the ages and acceptable on all occasion. Its nutritive value is much more than the synthetic products, which are available in the market throughout the country. For improving flavour, palatability and nutritive value, blending of two or more juices are used for preparation of RTS. Therefore, the production of new products being necessary for the survival and growth of the processing industry would also meet new tastes and demand in homes as well as the export market. Hence, there is an urgent need to develop some suitable technology for the preparation of custard apple beverages that could be economical and made available to a large population.

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MATERIALS AND METHODS

The well matured and ripened custard apple fruits were obtained from the farmer field. The fruits were washed and cleaned thoroughly and then peeling was done manually by hand. Two method of juice extraction were used for the preparation of the product.

– For cold method of juice / pulp extraction, the custard apple fruit were crushed in equal quantity of water and passed through pulper to remove seeds and peel.

– For hot method, fruits were crushed with equal quantity water and then heated upto 80ºC for softening. However, for blending, lime juice was extracted by type juice extractor. Then according to ratio proportion lime and custard apple were mixed. After that according to different receipe, syrup of sugar, water and citric acid was added. The prepared syrup was strained and added in custard apple juice. The prepared RTS beverage filled in clean, sterilized bottles of 200 ml and then air tight by crown corking machine. The filled bottles of RTS beverage were pasteurized in autoclave at a temperature of the 85^0C for 20 minutes. Prepared RTS beverage bottles were stored in dried place at ambient temperature which ranged from 10.60^0C (minimum) to 28.84^0C (maximum).

RESULTS AND DISCUSSION

Colour of the product is an important attribute, because it attracts the eyes of consumer and thus influences the market price. Thus colour retention of the product during storage was an important objective. The colour of the product decreased with the advancement of storage period (Table 1). It is evident from the data that hot method of pulp extraction was effective in retention of white colour of the product upto 90 days of storage. Whereas, all the treatment combinations with cold method of pulp extraction exhibited quick deterioration in colour of the produce. Dobhal (2000) also reported gradual increase in browning of phalsa RTS beverage, nectar and squash browning in RTS and squash of Rangpur lime was increased continuously during storage (Singh, 2002).

The deterioration of colour is due to enzymatic activity and oxidation in the product. The possible explanation for better retention of colour as a result at hot method of pulp extraction might be because of inactivation of enzymes due to heat treatment. Similar, beneficial effect of heat treatment for retention of the colour during storage of the product was recorded by Dube and Singh (1983) in bael, Mandhyan *et al*. (2000) in guava and Jain and Khurdiya (2002) in aonla.

The results indicate that the taste value of custard

Table 1 : Interaction effect of pulp/juice extraction method and recipe on colour of custard apple RTS beverage during storage

Treatments	Storage period (days)				
	0	30	60	90	120
Cold method x 15% juice + 15% TSS + 0.3 % acidity	W	OW	C	LB	B
Cold method x 20% juice + 15% TSS + 0.3 % acidity	W	OW	C	LB	B
Cold method x 25% juice + 15% TSS + 0.3 % acidity	W	OW	C	LB	B
Cold method x 15% blended juice of custard apple and lime (3 : 1) + 15% TSS + 0.3 % acidity	W	OW	C	LB	B
Cold method x 20% blended juice of custard apple and lime (2 : 1) + 15% TSS + 0.3 % acidity	W	OW	C	LB	B
Cold method x 25% blended juice of custard apple and lime (1 : 1) + 15% TSS + 0.3 % acidity	W	OW	C	LB	B
Hot method x 15% juice + 15% TSS + 0.3 % acidity	W	W	W	W	OW
Hot method x 20% juice + 15% TSS + 0.3 % acidity	W	W	W	W	OW
Hot method x 25% juice + 15% TSS + 0.3 % acidity	W	W	W	W	OW
Hot method x 15% blended juice of custard apple and lime (3 : 1) + 15% TSS + 0.3 % acidity	W	W	W	W	OW
Hot method x 20% blended juice of custard apple and lime (2 : 1) + 15% TSS + 0.3 % acidity	W	W	W	W	OW
Hot method x 25% blended juice of custard apple and lime (1 : 1) + 15% TSS + 0.3 % acidity	W	W	W	W	OW

W=White, OW=Off white, C=Creamish, LB=Light brown, B=Brown

Table 2 : Effect of pulp/juice extraction method on taste of custard apple RTS beverage during storage

Treatments	Taste value				
	Storage period (days)				
	0	30	60	90	120
Pulp/ Juice extraction method					
Cold method	8.18	7.30	6.41	5.21	4.51
Hot method	8.70	8.49	8.13	7.85	7.13
S.E. ±	0.094	0.066	0.053	0.070	0.062
C.D. (P=0.05)	0.275	0.193	0.154	0.205	0.182

apple RTS beverage decreased with the increase in storage period upto 120th day. The rate of reduction in taste value was significantly affected by pulp extraction method, recipe and their interaction. Among the cold and hot method of pulp extraction, the hot method resulted higher taste value throughout the storage period (Table 2). On 120th day of storage the highest taste value of 7.13 was recorded with hot method of pulp extraction which was significantly higher than cold method of pulp extraction. The higher taste value under hot method of pulp extraction might be due to inactivation of enzymatic activity by heat treatment, which resulted in slow deterioration process and helped in maintaining the organoleptic taste. To support the present results, Khurdia and Anand (1981) observed that the organoleptic quality of phalsa beverage was decreased during storage and it was acceptable only for four months. Kumar (1990) observed that papaya squash was acceptable upto three months of storage. Similar reduction in taste value of wood apple beverages (Singh, 1996), phalsa beverages (Dobhal, 2000) was reported during ambient storage.

Among the various recipe treatments in present study, the highest initial taste value (9.10) was recorded at treatment 15 % blended juice of custard apple and lime (3 : 1) + 15 % TSS + 0.3 % acidity and which remained highest during entire period of storage (Table 3). On 120th day of storage the maximum taste value of 6.73 was recorded of R_4 treatment as compared to the minimum of 5.15 at 15% juice + 15% TSS + 0.3 % acidity. The taste and quality were found to improve significantly by blending with apricot pulp, apple juice and apple juice concentrate as component to sand pear juice (control) and the blend with plum pulp. In the overall quality, the sand pear juice and apricot pulp blend of 80:20 was adjudged the best due to better taste (Attri *et al*., 1998). Similar, beneficial effect of blending of aonla and lime juice (lime 95 % + aonla 5 %) was recorded by Deka *et al*. (2001), which support the finding of the present study.

The reduction in taste value of the product during storage was significantly decreased due to interaction of pulp extraction method and recipe treatments (Table 4). However, on 120th day of storage the maximum taste value (8.40) was recorded at Hot method x 15% blended juice of custard apple and lime (3 : 1) + 15% TSS + 0.3 % acidity treatment as compared to minimum at Cold method x 15% juice + 15% TSS + 0.3 % acidity (3.97). This might be due to mutual complementary effect of these two factors.

The data on overall acceptance of custard apple RTS beverage (Table 5 to 7) revealed that it was decreased as the storage period increased. However, the rate of decrease was significantly influenced by method of juice

Table 3 : Effect of recipe on taste of custard apple RTS beverage during storage

Treatments	Taste value				
	Storage period (days)				
	0	30	60	90	120
Recipe					
15% juice + 15% TSS + 0.3 % acidity	8.15	7.65	7.10	6.22	5.15
20% juice + 15% TSS + 0.3 % acidity	8.43	7.97	7.32	6.38	5.45
25% juice + 15% TSS + 0.3 % acidity	8.65	8.22	7.48	6.68	5.93
15% blended juice of custard apple and lime (3 : 1) + 15% TSS + 0.3 % acidity	9.10	8.40	7.82	7.27	6.73
20% blended juice of custard apple and lime (2 : 1) + 15% TSS + 0.3 % acidity	8.37	7.67	7.13	6.67	6.08
25% blended juice of custard apple and lime (1 : 1) + 15% TSS + 0.3 % acidity	7.95	7.48	6.77	5.95	5.57
S.E. ±	0.163	0.114	0.092	0.122	0.108
C.D. (P=0.05)	0.477	0.334	0.267	0.356	0.315

Table 4 : Interaction effect of pulp/juice extraction method and recipe on taste of custard apple RTS beverage during storage

Treatments	Taste value				
	Storage period (days)				
	0	30	60	90	120
Cold method x 15% juice + 15% TSS + 0.3 % acidity	7.83	7.20	6.40	4.70	3.97
Cold method x 20% juice + 15% TSS + 0.3 % acidity	8.23	7.33	6.60	4.83	4.27
Cold method x 25% juice + 15% TSS + 0.3 % acidity	8.33	7.70	6.73	5.40	4.77
Cold method x 15% blended juice of custard apple and lime (3 : 1) + 15% TSS + 0.3 % acidity	8.93	7.80	6.83	6.00	5.07
Cold method x 20% blended juice of custard apple and lime (2 : 1) + 15% TSS + 0.3 % acidity	8.07	6.90	6.03	5.67	4.73
Cold method x 25% blended juice of custard apple and lime (1 : 1) + 15% TSS + 0.3 % acidity	7.70	6.87	5.83	4.63	4.23
Hot method x 15% juice + 15% TSS + 0.3 % acidity	8.47	8.10	7.80	7.73	6.33
Hot method x 20% juice + 15% TSS + 0.3 % acidity	8.63	8.60	8.03	7.93	6.63
Hot method x 25% juice + 15% TSS + 0.3 % acidity	8.97	8.73	8.23	7.97	7.10
Hot method x 15% blended juice of custard apple and lime (3 : 1) + 15% TSS + 0.3 % acidity	9.27	9.00	8.80	8.53	8.40
Hot method x 20% blended juice of custard apple and lime (2 : 1) + 15% TSS + 0.3 % acidity	8.67	8.43	8.23	7.67	7.00
Hot method x 25% blended juice of custard apple and lime (1 : 1) + 15% TSS + 0.3 % acidity	8.20	8.10	7.70	7.27	6.90
S.E. ±	0.231	0.162	0.129	0.172	0.153
C.D. (P=0.05)	NS	NS	0.378	0.503	0.446

NS=Non-significant

Table 5 : Effect of pulp/juice extraction method on overall acceptance of custard apple RTS beverage during storage

Treatments	Overall acceptance value				
	Storage period (days)				
	0	30	60	90	120
Pulp/juice extraction method					
Cold method	9.00	6.52	6.30	5.32	4.30
Hot method	9.00	7.45	7.07	6.87	6.56
S.E. ±	-	0.051	0.061	0.071	0.049
C.D. (P=0.05)	-	0.148	0.179	0.208	0.143

extraction, recipe and their combinations. The hot method of pulp extraction exhibited the highest overall acceptance during entire period of storage as compared to cold method (Table 5). On 120th day of storage the minimum overall acceptance score decreased from 9.00 to 6.56 with hot method of pulp extraction as compared to maximum from 9.00 to 4.30 at cold method. The colour, flavour, taste and general appearance are important consideration of overall acceptance of the product. As discussed earlier that the hot method of pulp extraction helped in maintaining the colour, flavour, taste and appearance of the product during storage, which ultimately resulted in higher overall acceptance scores upto 120 days of storage. The present findings are in accordance with findings reported by Khurdia and Anand (1981) in Phalsa and Jain *et al*. (1984) in lemon, orange, bael fruit squashes. Similarly, the application of various recipe treatments had significant effect in overall acceptance of the product during entire period of storage (Table 6). In the present study, the minimum reduction in overall acceptance was record at treatment 15% blended juice of custard apple and lime (3:1) + 15 % TSS + 0.3 % acidity *i.e.* 9.00 to 6.03. However, treatment 25 % blended juice of custard apple and lime (1:1) + 15% TSS 0.3 % acidity exhibited highest reduction of overall acceptance

i.e. 9.00 to 4.92. Similar results have been obtained by Rao *et al*. (1979) who reported that the blends containing Rangpur lime and acid lime (15:10 and 20:5) resulted in higher flavour and consistency. Tiwari (2000) concluded that blending of 30 per cent papaya pulp with 70 per cent guava pulp improved the nutritional quality and overall acceptance of RTS beverages.

The combined application of pulp extraction method and recipe treatment had significantly reduced the rate of reduction in overall acceptance of custard apple RTS beverage. On 120th day of storage, the minimum reduction in overall acceptance from 9.00 to 7.43 was recorded at hot method x 15% blended juice of custard apple and lime (3 : 1) + 15% TSS + 0.3 % acidity treatment, whereas the maximum reduction from 9.00 to 3.87 at cold method x 25% blended juice of custard apple and lime (1 : 1) + 15%

Table 6 : Effect of recipe on overall acceptance of custard apple RTS beverage during storage

Treatments	Overall acceptance value				
	Storage period (days)				
	0	30	60	90	120
Recipe					
15% juice + 15% TSS + 0.3 % acidity	9.00	6.85	6.35	5.97	5.28
20% juice + 15% TSS + 0.3 % acidity	9.00	6.77	6.52	6.18	5.50
25% juice + 15% TSS + 0.3 % acidity	9.00	7.12	6.95	6.65	5.70
15% blended juice of custard apple and lime (3 : 1) + 15% TSS + 0.3 % acidity	9.00	7.38	7.18	6.40	6.03
20% blended juice of custard apple and lime (2 : 1) + 15% TSS + 0.3 % acidity	9.00	7.13	6.90	5.90	5.13
25% blended juice of custard apple and lime (1 : 1) + 15% TSS + 0.3 % acidity	9.00	6.67	6.22	5.45	4.92
S.E. ±	-	0.088	0.106	0.123	0.085
C.D. (P=0.05)	-	0.256	0.310	0.360	0.247

Table 7 : Interaction effect of pulp/juice extraction method and recipe on overall acceptance of custard apple RTS beverage during storage

Treatments	Overall acceptance value				
	Storage period (days)				
	0	30	60	90	120
Cold method x 15% juice + 15% TSS + 0.3 % acidity	9.00	6.33	6.10	5.37	4.30
Cold method x 20% juice + 15% TSS + 0.3 % acidity	9.00	6.40	6.10	5.57	4.33
Cold method x 25% juice + 15% TSS + 0.3 % acidity	9.00	6.43	6.40	6.07	4.50
Cold method x 15% blended juice of custard apple and lime (3 : 1) + 15% TSS + 0.3 % acidity	9.00	6.57	6.57	5.20	4.63
Cold method x 20% blended juice of custard apple and lime (2 : 1) + 15% TSS + 0.3 % acidity	9.00	6.97	6.60	4.90	4.17
Cold method x 25% blended juice of custard apple and lime (1 : 1) + 15% TSS + 0.3 % acidity	9.00	6.43	6.03	4.80	3.87
Hot method x 15% juice + 15% TSS + 0.3 % acidity	9.00	7.37	6.60	6.57	6.27
Hot method x 20% juice + 15% TSS + 0.3 % acidity	9.00	7.13	6.93	6.80	6.67
Hot method x 25% juice + 15% TSS + 0.3 % acidity	9.00	7.80	7.50	7.23	6.90
Hot method x 15% blended juice of custard apple and lime (3 : 1) + 15% TSS + 0.3 % acidity	9.00	8.20	7.80	7.60	7.43
Hot method x 20% blended juice of custard apple and lime (2 : 1) + 15% TSS + 0.3 % acidity	9.00	7.30	7.20	6.90	6.10
Hot method x 25% blended juice of custard apple and lime (1 : 1) + 15% TSS + 0.3 % acidity	9.00	6.90	6.40	6.10	5.97
S.E. ±	-	0.124	0.150	0.175	0.120
C.D. (P=0.05)	-	0.362	0.438	0.509	0.350

TSS + 0.3 % acidity treatment (Table 7). This might be due to mutual complementary effect of these two factors.

Among various chemical parameters, ascorbic acid or vitamin 'C' is very important qualitative parameter of custard apple RTS beverages. Minimum loss of ascorbic acid from product during storage is therefore of utmost importance. In the present study the ascorbic acid content of custard apple RTS beverage decreased as the storage period increased (Table 8 to 10). It is evident from the data that cold method of pulp extraction resulted higher initial ascorbic acid content of the product as compared to hot method of pulp extraction. The rate of decrease in ascorbic acid content was significantly affected by method of pulp extraction. On 120th day of storage maximum retention of ascorbic acid of 5.12 mg/100 ml RTS beverage was recorded with cold method of pulp extraction (Table 8). Similarly, among the various recipe treatments, the custard apple pulp blended with lime juice exhibited higher initial ascorbic acid content. The decrease in ascorbic acid content was significantly influenced by different recipe treatments. At the end of storage, the maximum retention of ascorbic acid content of 5.93 mg/100 ml RTS beverage was recorded at treatment 25 % blended juice of custard apple and lime (1:1) + 15% TSS + 0.3 % acidity as compared to 15% juice + 15% TSS + 0.3% acidity *i.e.* 3.96 mg/100 ml RTS beverage (Table 9). The decrease in ascorbic acid in RTS beverage during storage might be due to oxidation or irreversible conversion of L-ascorbic acid into de hydro ascorbic acid oxidase (ascorbimase). Similar reduction in ascorbic acid content has also been reported in guava beverage (Pandey and Singh, 1998). Rabbani (1992) observed that ascorbic acid content decreased continuously during storage of mango beverages. Singh (1996) reported decreasing trend in the level of ascorbic acid content of wood apple and monkey jack beverages during ambient storage condition. Singh (2000) found continuous decrease in the level of ascorbic acid in RTS and squash of carambola fruit during six months of storage.

In the present study, the higher ascorbic acid content at different recipe treatment having custard apple pulp blended with lime juice is due to the additional ascorbic acid content received from the lime juice.

The combined effect of pulp extraction method and recipe treatments were found to be significant on ascorbic acid content of product during entire period of storage (Table 10). On 120th day of storage the maximum retention of ascorbic acid content (6.27 mg/100 ml RTS) was recorded at cold method x 25% blended juice of custard apple and lime (1 : 1) + 15% TSS + 0.3 % acidity treatment

Table 8 : Effect of pulp/juice extraction method on ascorbic content of custard apple RTS beverage during storage (mg/100 ml RTS)

Treatments	Ascorbic acid (mg/100 ml RTS) Storage period (days)				
	0	30	60	90	120
Pulp/juice extraction method					
Cold method	7.44	7.01	6.31	5.71	5.12
Hot method	6.89	6.56	5.80	5.28	4.75
S.E. ±	0.053	0.057	0.046	0.046	0.039
C.D. (P=0.05)	0.156	0.167	0.134	0.133	0.114

Table 9 : Effect of recipe on ascorbic acid content of custard apple RTS beverage during storage (mg/100 ml RTS)

Treatments	Ascorbic acid (mg/100 ml RTS) Storage period (days)				
	0	30	60	90	120
Recipe					
15% juice + 15% TSS + 0.3 % acidity	6.05	5.74	4.99	4.47	3.96
20% juice + 15% TSS + 0.3 % acidity	6.44	6.06	5.33	4.77	4.24
25% juice + 15% TSS + 0.3 % acidity)	6.80	6.53	5.68	5.21	4.55
15% blended juice of custard apple and lime (3 : 1) + 15% TSS + 0.3 % acidity	7.46	7.05	6.42	5.82	5.30
20% blended juice of custard apple and lime (2 : 1) + 15% TSS + 0.3 % acidity	7.86	7.42	6.75	6.16	5.65
25% blended juice of custard apple and lime (1 : 1) + 15% TSS + 0.3 % acidity	8.38	7.91	7.16	6.55	5.93
S.E. ±	0.092	0.099	0.079	0.079	0.068
C.D. (P=0.05)	0.270	0.290	0.232	0.231	0.197

Table 10 : Interaction effect of pulp/juice extraction method and recipe on ascorbic acid content of custard apple RTS beverage during storage (mg/100 ml RTS)

Treatments	Ascorbic acid (mg/100 ml RTS)				
	Storage period (days)				
	0	30	60	90	120
Cold method x 15% juice + 15% TSS + 0.3 % acidity	6.47	6.14	5.32	4.83	4.19
Cold method x 20% juice + 15% TSS + 0.3 % acidity	6.81	6.39	5.57	4.99	4.42
Cold method x 25% juice + 15% TSS + 0.3 % acidity	7.20	6.90	5.96	5.37	4.76
Cold method x 15% blended juice of custard apple and lime (3 : 1) + 15% TSS + 0.3 % acidity	7.48	7.06	6.43	5.83	5.30
Cold method x 20% blended juice of custard apple and lime (2 : 1) + 15% TSS + 0.3 % acidity	8.08	7.54	7.09	6.43	5.80
Cold method x 25% blended juice of custard apple and lime (1 : 1) + 15% TSS + 0.3 % acidity	8.58	8.00	7.51	6.84	6.27
Hot method x 15% juice + 15% TSS + 0.3 % acidity	5.63	5.33	4.65	4.11	3.72
Hot method x 20% juice + 15% TSS + 0.3 % acidity	6.06	5.72	5.09	4.56	4.07
Hot method x 25% juice + 15% TSS + 0.3 % acidity	6.40	6.16	5.41	5.04	4.34
Hot method x 15% blended juice of custard apple and lime (3 : 1) + 15% TSS + 0.3 % acidity	7.44	7.04	6.41	5.81	5.29
Hot method x 20% blended juice of custard apple and lime (2 : 1) + 15% TSS + 0.3 % acidity	7.65	7.29	6.40	5.89	5.49
Hot method x 25% blended juice of custard apple and lime (1 : 1) + 15% TSS + 0.3 % acidity	8.19	7.81	6.80	6.26	5.58
S.E. ±	0.131	0.140	0.112	0.112	0.096
C.D. (P=0.05)	0.381	0.409	0.328	0.327	0.279

followed by cold method x 20% blended juice of custard apple and lime (2 : 1) + 15% TSS + 0.3 % acidity (5.80 mg/100 ml RTS). The minimum retention of ascorbic acid content (3.72 mg/100 ml RTS) was recorded at hot method x 15% juice + 15% TSS + 0.3 % acidity treatment. Similar, beneficial effect of blending with mixture of fruit juice was recorded by Attri *et al*. (1998) in pear with apple, apricot and plum, Deka (2000) in mango, which strongly support the present findings.

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