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Effect of blending, additives and storage conditions on the quality of watermelon nectar

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ABSTRACT

The impact of blending of nectar with coconut water, fortification with ascorbic acid and tocopherol and subsequent storage at low temperature (4-5^{o}C) and room temperature (15-33^{o}C) on the quality of nectar was evaluated. In most of the treatments, total soluble solids and reducing sugar content of the nectars increased during storage, whereas the total titratable acidity and lycopene content decreased. Blending and addition of tocopherol did not show improved effect on quality. Low temperature storage recorded better stability.

Key words: Watermelon nectar; total soluble solid, reducing sugar, lycopene, titratable acidity, blending, additives, storage

INTRODUCTION

Watermelon (*Citrullus lanatus*) is an important cucurbitaceous crop, which is widely grown in our country and is highly relished due to its cool and thirst quenching property. The edible portion of the fruit forms about 60% of the whole fruit and juice is the major product for which the fruit is processed (Teotia *et al,* 1988). Watermelon juice contains a fair amount of vitamin 'C', Vitamin 'A' precursor (lycopene) and a high content of potassium, which is believed to have valuable diuretic properties (Gusina and Trostinskaya, 1974). Because of its high juice content, beverages such as nectars are the obvious choice, which will satisfy thirst, supplement nutritional requirements as well as help in stabilizing the market price. Blending of juice add variety in terms of flavour as well as nutritional value, and may result in product that possess the combined advantage of two or more fruits. Coconut water can be utilized in the processing industry for blending. Tender coconut water and pineapple juice, blended beverage can form an ideal health drink (Illaiaskutty *et al,* 2002). Teotia *et al* (1997) also observed that fortification of muskmelon RTS with ascorbic acid improved the quality of the beverage. In light of the above, the present study was carried out to prepare a stable beverage product from watermelon fruit.

MATERIAL AND METHODS

The experiment was conducted at the department of Post Harvest Technology of Horticultural Crops, Faculty of Horticulture, B.C.K.V., Mohanpur, Nadia, West Bengal. The nectars were prepared during the months of May and September 2006.

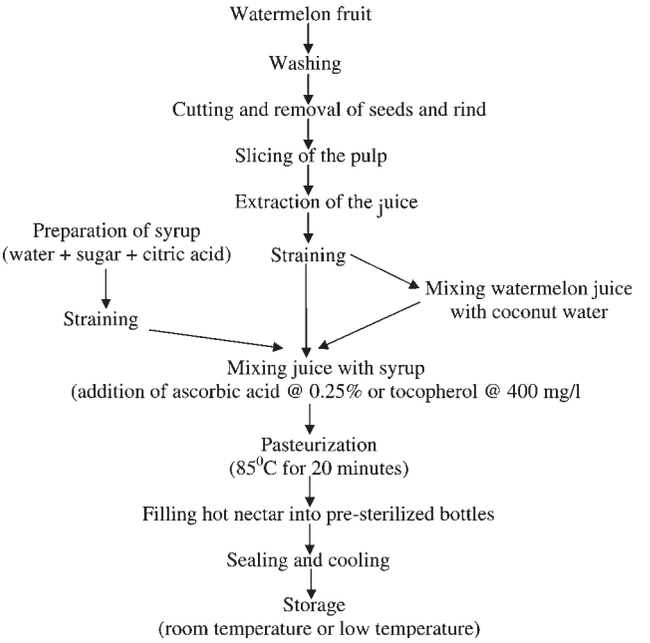

Fig 1 Steps followed for processing of watermelon nectar

Recipe

The following different recipes were used for preparing watermelon nectars (Table 1) with different treatments so as to ascertain that the final product should contain 20% juice, 15% TSS and 0.3% acidity as per the Fruit Products Order specification for nectars.

Table 1. Different receipes used for preparing watermelon nectar

Ingredients	Watermelon nectar without blending	Watermelon juice and coconut water blended (50:50) nectar
Watermelon juice	200 ml	100 ml
Coconut water	—	100 ml
Sugar	129.6 g	134.7 g
Citric acid	3 g	3 g
Water	667.4 ml	662.3 ml
Finished product	1 litre	1 litre
Treatments	Control or ascorbic acid (0.25%)- 2.5 g/l of finished product or tocopherol- 400 mg/l of finished product	Control or ascorbic acid (0.25%)- 2.5 g/l of finished product or tocopherol- 400 mg/l of finished product

TSS content of extracted watermelon juice - 10.2°Brix

TSS content of watermelon juice: coconut water mixture - 7.5°Brix

Acidity of watermelon juice - 0.02%

Acidity of watermelon juice: coconut water mixture - 0.02%

Total soluble solids was determined using an Erma hand refractometer. Titratable acidity, reducing sugar and lycopene content were estimated following AOAC (1984). Statistical analysis was carried out according to Gomez and Gomez (1983). Completely Randomized Design was followed for data interpretation.

Sensory evaluation

The samples were evaluated by a panel of ten judges for three quality parameters viz., colour, taste and flavour with a possible scores of 40, 30 and 30, respectively.

Table 2. Effect of blending, additives and storage condition on the total soluble solids (^{0}Brix) content of watermelon nectar

	Blending (watermelon juice: coconut water)	Additives	Storage condition	Storage period (months)			
				0	3	6	9
Effect of blending (watermelon juice: coconut water)							
	100 : 0	—	—	16.9	17.0	17.0	17.1
	50 : 50	—	—	16.6	16.6	16.7	16.8
S.Em ±				0.027	0.015	0.015	0.021
CD *(P=0.05)*				0.079	0.044	0.044	0.063
Effect of additives							
	—	Ascorbic acid	—	16.4	16.5	16.6	16.5
	—	Tocopherol	—	16.5	16.6	16.7	16.9
	—	Control	—	17.4	17.5	17.4	17.5
S.Em ±				0.033	0.018	0.018	0.026
CD *(P=0.05)*				0.096	0.052	0.054	0.077
Effect of storage condition							
	—	—	RT	16.8	16.9	16.9	17.1
	—	—	LT	16.8	16.8	16.8	16.9
S.Em ±				0.027	0.015	0.015	0.021
CD *(P=0.05)*				NS	NS	0.044	0.063
Effect of interaction							
	100 : 0	Ascorbic acid	RT	16.8	17.0	17.2	17.0
	100 : 0	Ascorbic acid	LT	16.8	16.8	16.8	16.9
	100 : 0	Tocopherol	RT	16.4	16.6	16.7	16.9
	100 : 0	Tocopherol	LT	16.4	16.4	16.5	16.6
	100 : 0	—	RT	17.8	17.8	17.6	17.7
	100 : 0	—	LT	17.8	17.8	17.7	17.7
	50 : 50	Ascorbic acid	RT	16.0	16.1	16.2	16.2
	50 : 50	Ascorbic acid	LT	16.0	16.1	16.1	16.0
	50 : 50	Tocopherol	RT	16.8	16.7	16.8	17.2
	50 : 50	Tocopherol	LT	16.8	16.9	16.7	17.0
	50 : 50	—	RT	17.0	17.2	17.3	17.6
	50 : 50	—	LT	17.0	17.0	0.037	17.2
S.Em ±				0.067	0.037	0.108	0.053
CD *(P=0.05)*				NS	0.108	0.108	NS

RT = Room temperature (15^0-31^0C) LT = Low temperature (4^0-5^0C) NS = Non-significant

RESULTS AND DISCUSSION

Total soluble solids (TSS)

TSS content during storage increased (Table 2) more prominently in the nectar blended with coconut water compared to the unblended samples. Storage under low temperature condition (4°-5°C) showed less change in TSS content as compared to the room temperature (15°-33°C) stored samples. The unblended watermelon nectars fortified with ascorbic acid and stored under low temperature condition (4°-5°C) showed minimum change in TSS content during storage whereas the unblended watermelon nectar with tocopherol treatment and stored under room temperature condition (15°-33°C) showed maximum change in TSS content during the nine months of storage. The increase in soluble solid content of the nectars during storage may be attributed to partial hydrolysis of complex carbohydrates (Awan *et al*, 1980). Similar observation in storage of squashes of orange, lemon and bael fruits were reported by Jain *et al* (1984).

Reducing sugar

The reducing sugar content of watermelon nectars showed an increasing trend during storage irrespective of the treatments and storage conditions (Table 3). However, this change was slightly higher in the blended watermelon nectars as compared to the unblended materials. Fortification with ascorbic acid showed lesser change in reducing sugar as compared to those fortified with tocopherol or without fortification (control). The change in reducing sugar was also comparatively slower under low temperature storage than under room temperature storage

Table 3. Effect of blending, additives and storage condition on the reducing sugar content (%) of watermelon nectar

	Blend (watermelon juice: coconut water)	Additives	Storage condition	Storage period (months)			
				0	3	6	9
Effect of blending (watermelon juice : coconut water)							
	100 : 0	—	—	8.26	8.41	8.57	8.73
	50 : 50	—	—	8.05	8.20	8.40	8.58
S.Em ±				0.019	0.006	0.021	0.003
CD *(P=0.05)*				0.057	0.018	0.062	0.009
Effect of additives							
	—	Ascorbic acid	—	8.22	8.32	8.49	8.58
	—	Tocopherol	—	7.66	7.88	8.11	8.28
	—	Control	—	8.59	8.72	8.86	9.10
S.Em ±				0.024	0.007	0.026	0.004
CD *(P=0.05)*				0.071	0.022	0.076	0.012
Effect of storage condition							
	—	—	RT	8.17	8.37	8.63	8.86
	—	—	LT	8.14	8.25	8.34	8.45
S.Em ±				0.019	0.006	0.021	0.003
CD *(P=0.05)*				NS	0.018	0.062	0.009
Effect of interaction							
	100 : 0	Ascorbic acid	RT	8.69	8.83	8.78	9.24
	100 : 0	Ascorbic acid	LT	8.69	8.71	8.28	8.82
	100 : 0	Tocopherol	RT	7.80	8.04	8.02	8.51
	100 : 0	Tocopherol	LT	7.80	7.98	8.82	8.17
	100 : 0	—	RT	8.21	8.58	8.24	9.22
	100 : 0	—	LT	8.21	8.35	8.14	8.47
	50 : 50	Ascorbic acid	RT	7.76	7.92	7.97	8.28
	50 : 50	Ascorbic acid	LT	7.76	7.82	8.08	8.02
	50 : 50	Tocopherol	RT	7.52	7.81	7.90	8.43
	50 : 50	Tocopherol	LT	7.52	7.71	9.24	8.08
	50 : 50	—	RT	8.89	9.02	9.07	9.53
	50 : 50	—	LT	8.89	8.95	0.052	9.20
S.Em ±				0.048	0.015	NS	0.008
CD *(P=0.05)*				NS	0.043		0.024

RT = Room temperature (15^0-31^0C) LT = Low temperature (4^0-5^0C) NS = Non-significant

which is in agreement with the findings on watermelon juice made by Chahal and Saini (1999) and also on mango nectar by Sahni and Khurdiya (1989). Increase in reducing sugar during storage was observed in watermelon juice by Bawa and Bains (1977) and also in muskmelon RTS (Teotia *et al*, 1997). The increase in reducing sugars during storage may be attributed to hydrolysis of non-reducing sugars to reducing sugars, and a higher storage temperature and acidity accelerated the process of hydrolysis (Sahni and Khurdiya, 1989). Among all the treatments, there was minimum increase in reducing sugar content in the unblended watermelon nectar which was fortified with ascorbic acid and stored under low temperature (4°-5°C). Maximum increase in reducing sugar content was recorded in the watermelon nectar blended with coconut water and fortified with tocopherol and stored at room temperature (15°-33°C).

Total titratable acidity

The total titratable acidity of the watermelon nectars decreased throughout the period of storage for six months irrespective of the treatments and storage conditions (Table 4). The decrease in acidity of the nectars during storage was more rapid in the nectars with coconut water than in unblended samples. There was a significant difference in acid levels during storage with addition of different additives. The addition of ascorbic acid showed a slower lower change in the acid content as compared to the control and the tocopherol treatment showed a rapid increase in acidity during storage. Low temperature storage (4°-5°C) a significantly reduction in acid content as compared to the room temperature storage (15°-33°C). Least change in total titratable acidity was recorded in the unblended watermelon nectar with ascorbic acid fortification and storage under low temperature for nine

Table 4. Effect of blending, additives and storage condition on the titratable acidity (%) of watermelon nectar

	Blend (watermelon juice: coconut water)	Additives	Storage condition	Storage period (months)			
				0	3	6	9
Effect of blending (watermelon juice : coconut water)							
	100 : 0	—	—	0.45	0.43	0.38	0.34
	50 : 50	—	—	0.41	0.39	0.36	0.31
S.Em ±				0.002	0.003	0.005	0.002
CD *(P=0.05)*				0.006	0.007	0.016	0.006
Effect of additives							
	—	Ascorbic acid	—	0.45	0.42	0.40	0.36
	—	Tocopherol	—	0.39	0.37	0.33	0.27
	—	Control	—	0.45	0.43	0.38	0.35
S.Em ±				0.002	0.003	0.007	0.303
CD *(P=0.05)*				0.006	0.007	0.020	0.008
Effect of storage condition							
	—	—	RT	0.43	0.40	0.36	0.30
	—	—	LT	0.43	0.42	0.39	0.35
S.Em ±				0.002	0.003	0.005	0.003
CD *(P=0.05)!*				NS	0.007	0.016	0.007
Effect of interaction							
	100 : 0	Ascorbic acid	RT	0.45	0.42	0.38	0.32
	100 : 0	Ascorbic acid	LT	0.45	0.44	0.42	0.41
	100 : 0	Tocopherol	RT	0.40	0.38	0.29	0.24
	100 : 0	Tocopherol	LT	0.40	0.39	0.34	0.28
	100 : 0	—	RT	0.51	0.48	0.41	0.37
	100 : 0	—	LT	0.51	0.49	0.44	0.40
	50 : 50	Ascorbic acid	RT	0.46	0.41	0.38	0.32
	50 : 50	Ascorbic acid	LT	0.46	0.44	0.42	0.38
	50 : 50	Tocopherol	RT	0.39	0.35	0.32	0.26
	50 : 50	Tocopherol	LT	0.39	0.37	0.35	0.30
	50 : 50	—	RT	0.40	0.38	0.34	0.29
	50 : 50	—	LT	0.40	0.38	0.35	0.33
S.Em ±				0.005	0.006	0.014	0.006
CD *(P=0.05)*				NS	NS	NS	0.017

RT = Room temperature (15^0-31^0C) LT = Low temperature (4^0-5^0C) NS = Non-significant

months. Bawa and Bains (1977) also observed a slight decrease in acidity of stored watermelon juice.

Lycopene content

The lycopene content of the watermelon nectars decreased during storage for nine months both under low temperature (4° - 5°C) and room temperature (15° - 33°C) conditions (Table 5). The rate of decrease in lycopene content was slightly lower in the unblended watermelon nectars than those blended with coconut water. The nectars under room temperature storage (15° - 33°C) also showed slightly higher rate of decrease in lycopene content as compared to the nectars under low temperature storage (4° - 5°C). Gowda and Jalali (1995) also reported decrease in lycopene content of watermelon juice in storage. Lycopene is the dominant pigment found in watermelon juice which is responsible for the red colour (Huor *et al,* 1980).

Sensory quality

Data presented in Table 6 revealed that the sensory quality of watermelon nectars of different treatments maintained acceptable quality during the entire period of storage for nine months at low temperature condition (4° - 5° C). However, under room temperature condition (15° to 33° C) the quality was maintained upto six months of storage only. The quality rating of watermelon nectars of different treatments decreased with increase in duration of storage. The unblended watermelon nectar with ascorbic acid treatment stored under low temperature condition showed maximum quality rating of 91 at nine months of storage. The watermelon nectar with different treatments maintained higher scores of quality ratings i.e., above 70 at nine months of storage at low temperature.

Table 5. Effect of blending, additives and storage condition on the lycopene content (mg/100 ml) of watermelon nectar

	Blend (watermelon juice: coconut water)	Additives	Storage condition	Storage period (months)			
				0	3	6	9
Effect of blending (watermelon juice : coconut water)							
	100 : 0	—	—	564	517	457	423
	50 : 50	—	—	396	363	326	293
S.Em ±				0.373	0.479	0.497	0.437
CD *(P=0.05)*				1.086	1.396	1.447	1.274
Effect of additives							
	—	Ascorbic acid	—	488	453	394	367
	—	Tocopherol	—	463	418	375	344
	—	Control	—	487	449	405	362
S.Em ±				0.456	0.587	0.608	0.536
CD *(P=0.05)*				1.329	1.711	1.771	1.561
Effect of storage condition							
	—	—	RT	479	444	388	354
	—	—	LT	479	436	394	361
S.Em ±				0.373	0.479	0.497	0.437
CD *(P=0.05)*				NS	1.396	1.447	1.274
Effect of interaction							
	100 : 0	Ascorbic acid	RT	581	549	408	402
	100 : 0	Ascorbic acid	LT	581	543	517	486
	100 : 0	Tocopherol	RT	538	492	441	403
	100 : 0	Tocopherol	LT	538	481	432	397
	100 : 0	—	RT	572	523	481	425
	100 : 0	—	LT	572	517	464	423
	50 : 50	Ascorbic acid	RT	396	357	331	291
	50 : 50	Ascorbic acid	LT	396	363	321	289
	50 : 50	Tocopherol	RT	388	361	324	299
	50 : 50	Tocopherol	LT	388	341	303	278
	50 : 50	—	RT	403	385	345	302
	50 : 50	—	LT	403	372	331	297
S.Em ±				0.919	1.174	1.217	1.071
CD *(P=0.05)*				NS	3.422	3.546	3.121

RT = Room temperature (15°-31°C) LT = Low temperature (4°-5°C) NS = Non-significant

Table 6. Effect of blending, additives and storage condition on sensory quality scores of watermelon nectar

Blend (watermelon juice: coconut water)	Additives condition	Storage	Scores of sensory quality at different storage period (months)			
			0	3	6	9
100:0	Ascorbic acid	RT	97	95	88	48
100:0	Ascorbic acid	LT	97	97	95	91
100:0	Tocopherol	RT	96	90	87	43
100:0	Tocopherol	LT	96	96	93	85
100:0	-	RT	97	92	85	47
100:0	-	LT	97	97	94	83
50:50	Ascorbic acid	RT	83	77	72	24
50:50	Ascorbic acid	LT	83	83	82	71
50:50	Tocopherol	RT	84	75	70	43
50:50	Tocopherol	LT	84	84	81	70
50:50	-	RT	84	77	70	29
50:50	-	LT	84	84	81	71

RT = Room temperature (15^0-31^0C) LT = Low temperature (4^0-5^0C)

Thus, the total soluble solids and reducing sugar content of nectars increased during storage, whereas the total titratable acidity decreased. On the other hand, the lycopene content of the nectars decreased during storage irrespective of the storage condition. Blending watermelon with coconut water juice and supplementation with toopherol did not improve quality.

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