Effect of $CaCl_2$ and Citric acid on Physio-chemical Changes and Storage at Ambient Temperature of Cherry (*Prunus avium)* Candy

Abstract

The present experiment was carried out during 2022 in Post Harvest Laboratory of Department of Horticulture, SHUATS, Prayagraj. The experiment was conducted in Completely Randomized Design with 8 treatment replicated thrice. The treatments were **T_0** (Control), **T_1** (Application of $CaCl_2$ @1% +70 ºBrix sugar), **T_2**(Application of $CaCl_2$ @1.5% + 70 ºBrix sugar), **T_3** (Application of $CaCl_2$ @ 2%+ 70 ºBrix sugar), **T_4** (Application of Erythrosine @0.05%+ 70 ºBrix sugar), **T_5** (Application of Citric Acid @ 1%+ 70 ºBrix sugar), **T_6** (Application of Citric Acid @ 1.5%+ 70 ºBrix sugar), **T_7** (Application of Citric Acid @ 2% + 70 ºBrix sugar). On the basis of our experimental finding it was found that the treatment **T_2 (Application of $CaCl_2$ @1.5mg/100g + 70 ºBrix sugar)** was found to be best in the terms of TSS, Total sugar, Reducing sugar, Moisture content, Ascorbic acid, pH, Acidity %, Taste, Color and appearance, aroma, texture, overall acceptability and benefit cost ratio.

Keywords: Candy, Cherry, Quality parameters, Organoleptic parameters and Benefit cost ratio.

Introduction

Fruits are among the most important foods of mankind as they are both nutritive and indispensable for maintenance of health. Being rich source of carbohydrates, minerals, vitamins and dietary fibres, these constitute an important part of our daily diet. Moreover, they add flavour and diversity to diet. Cherry (*Prunus avium* L.) belonging to family Rosaceae is one of the most important fruit crops of temperate region of the world. In India, Jammu and Kashmir is the main cherry growing state having 2,570 hectares under this crop with the annual production of about 8,296 metric tones.

Shelf life of cherry fruit is very less and large quantities get wasted. Also there is lack of efficient post-harvest management of cherries, which leads to the rapid quality deterioration and sudden glut in the market. This crop can be saved from wastage and at the same time, can be converted into more valuable and priced commodity by processing into various products . Various products prepared from cherries are juice, frozen cherries, dehydrated cherries, canned products, cherry jam, cherry juice concentrate, cherry juice powder, cherry bars and cherry candies.

Candy is a sweet food prepared from fruits or vegetables by impregnating them with sugar syrup followed by draining of excessive syrup and then drying the product to a shelf stable state. Fruits and vegetables like apples, ginger, mangoes, guava, carrots and citrus peels have been used to prepare candies . Caronda, ber and Aonla candies have also been developed . Candied products available these days are descended from the simplest confections first made more than 4,000 years ago.

Candy making is fairly simple process. In traditional candy production, a mixture of sugar, water, and possibly corn syrup are mixed together and boiled until sufficient water has been boiled out of the candy mass. Current candy preparation techniques are grouped as semi-solid or soft candy (e.g., chocolate-based, fruit-based, including tamarind, apple, cherry etc.) with or without chili or other visible particulate ingredients (i.e., Chaca-Chaca, Pelon-Pelon Rico), hard candy with or without visible particulate ingredient (chili) either in the candy or on the surface of the candy, hard candy with supplemental but separate salt and chili and powdered sugar or flavored salt products with or without other particulate ingredients.

Materials and Methods

The area of Prayagraj district comes under subtropical belt in the south east of Utter Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46^{o} C-48^{o} C and seldom falls as low as 4^{o}C- 5^{o}C. The relative humidity ranges between 20 to 94 %. The average rainfall in this area is around 1013.4 mm annually. However, occasional precipitation is also not uncommon during winter months.

The experiment was conducted in Completely Randomized Design with 8 treatment replicated thrice with an objective to find out the quality and economics of the cherry candy. The treatments were **T_0** (Control), **T_1** (Application of $CaCl_2$ @1% +70 ^{o}Brix sugar), **T_2**(Application of $CaCl_2$ @1.5% + 70 ^{o}Brix sugar), **T_3** (Application of $CaCl_2$ @ 2%+ 70 ^{o}Brix sugar), **T_4** (Application of Erythrosine @0.05%+ 70 ^{o}Brix sugar), **T_5** (Application of Citric Acid @ 1%+ 70 ^{o}Brix sugar), **T_6** (Application of Citric Acid @ 1.5%+ 70 ^{o}Brix sugar), **T_7** (Application of Citric Acid @ 2% + 70 ^{o}Brix sugar).

Results and Discussion

The maximum Total soluble solid content in cherry candy was recorded in T_2 (Application of CaCl2 @1.5% + 70 ^{o}Brix sugar) with 66.90 ^{0}B followed by T_7 (Application of Citric Acid @ 2% + 70 ^{o}Brix sugar) with 66.30 ^{0}B and the minimum was recorded in T_0 (Control) with 65.10 ^{0}B. A slight increase in total soluble solids during storage might be due to conversion of polysaccharides (present in fruits) into sugars during hydrolysis process. This finding agreed with the finding of **Vikram and Prasad (2014)** compositional changes in value-added Kinnow-Aonla RTS revealed that there was increase in the level of TSS during the storage period (six months) and **(Jain *et al.*, 2007)** in aonla RTS beverage.

The maximum Total Sugar content in cherry candy was recorded in T_2 (Application of CaCl2 @1.5% + 70 ^{o}Brix sugar) with 51.92 % followed by T_7 (Application of Citric Acid @ 2% + 70 ^{o}Brix sugar) with 51.53 % and the minimum was recorded in T_0 (Control) with 50.00 %.

A slight increase in Total Sugars during storage might be due to conversion of polysaccharides (present in fruits) into sugars during hydrolysis process. This

finding agreed with the finding of **Vikram and Prasad (2014)** compositional changes in value-added Kinnow-Aonla RTS revealed that there was increase in the level of total sugar during the storage period (six months) and **(Jain *et al.,* 2007)** in aonla RTS beverage.

The maximum Reducing sugar content in cherry candy was recorded in T_2 (Application of $CaCl_2$ @1.5% + 70 ºBrix sugar) with 28.35 % followed by T_7 (Application of Citric Acid @ 2% + 70 ºBrix sugar) with 27.96 % and the minimum was recorded in T_0 (Control) with 26.43 %. A slight increase in Reducing sugars during storage might be due to conversion of polysaccharides (present in fruits) into sugars during hydrolysis process. This finding agreed with the finding of **Vikram and Prasad (2014)** compositional changes in value-added Kinnow-Aonla RTS revealed that there was increase in the level of reducing sugar during the storage period (six months) and **(Jain *et al.,* 2007)** in aonla RTS beverage.

The maximum Moisture content content in cherry candy was recorded in T_2 (Application of $CaCl_2$ @1.5% + 70 ºBrix sugar) with 16.90 % followed by T_7 (Application of Citric Acid @ 2% + 70 ºBrix sugar) with 16.51 % and the minimum was recorded in T_0 (Control) with 14.98 %. A slight increase in Moisture contents during storage might be due to conversion of polysaccharides (present in fruits) into sugars during hydrolysis process. This finding agreed with the finding of **Vikram and Prasad (2014)** compositional changes in value-added Kinnow-Aonla RTS revealed that there was increase in the level of Moisture content during the storage period (six months) and **(Jain *et al.,* 2007)** in aonla RTS beverage.

The maximum ascorbic acid content in cherry candy was recorded in T_2 (Application of $CaCl_2$ @1.5mg/100g + 70 ºBrix sugar) with 304 mg/100g followed by T_7 (Application of Citric Acid @ 2mg/100g + 70 ºBrix sugar) with 224 mg/100g and the minimum was recorded in T_0 (Control) with 145 mg/100g. A slight increase in ascorbic acid during storage might be due to conversion of polysaccharides (present in fruits) into sugars during hydrolysis process. This finding agreed with the finding of **Vikram and Prasad (2014)** compositional changes in value-added Kinnow-Aonla RTS revealed that there was increase in the level of Vitamin C during the storage period (six months) and **(Jain *et al.,* 2007)** in aonla RTS beverage.

The maximum pH content in cherry candy was recorded in T_2 (Application of $CaCl_2$ @1.5mg/100g + 70 ºBrix sugar) with 4.05 followed by T_7 (Application of Citric Acid @ 2mg/100g + 70 ºBrix sugar) with 4.03 and the minimum was recorded in T_0 (Control) with 26.43. A slight increase in pH during storage might be due to conversion of polysaccharides (present in fruits) into sugars during hydrolysis process. This finding agreed with the finding of **Vikram and Prasad (2014)** compositional changes in value-added Kinnow-Aonla RTS revealed that there was increase in the level of pH during the storage period (six months) and **(Jain *et al.*, 2007)** in aonla RTS beverage.

The maximum Acidity % content in cherry candy was recorded in T_2 (Application of $CaCl_2$ @1.5mg/100g + 70 ºBrix sugar) with 28.35 mg/100g followed by T_7 (Application of Citric Acid @ 2mg/100g + 70 ºBrix sugar) with 27.96 mg/100g and the minimum was recorded in T_0 (Control) with 26.43 mg/100g. A slight increase in Acidity % during storage might be due to conversion of polysaccharides (present in fruits) into sugars during hydrolysis process. This finding agreed with the finding of **Vikram and Prasad (2014)** compositional changes in value-added Kinnow-Aonla RTS revealed that there was increase in the level of acidity % during the storage period (six months) and **(Jain *et al.*, 2007)** in aonla RTS beverage.

The maximum score for taste in cherry candy was recorded in T_2 (Application of $CaCl_2$ @1.5mg/100g + 70 ºBrix sugar) with 7.60 followed by T_7 (Application of Citric Acid @ 2mg/100g + 70 ºBrix sugar) with 7.40 and the minimum was recorded in T_0 (Control) with 6.50. The decreasing trend was observed for flavour, taste and texture with increase storage period. This might be due to degradation of volatile substance and flavor constituents. Similar result was reported by **Nayak *et al.*, (2011)** in aonla segments-in-syrup prepared from stored fruits. **Jain *et al.* (2007)** in aonla RTS beverage. It could be attributed to non enzymatic reactions, which occur between nitrogenous compounds and sugars or organic acid and organic acids with sugars. Similar results were reported by **Syed *et al.* (2011)** in sweet orange based products.

The maximum score for Color and appearance in cherry candy was recorded in T_2 (Application of $CaCl_2$ @1.5mg/100g + 70 ºBrix sugar) with 7.50 followed by T_7 (Application of Citric Acid @ 2mg/100g + 70 ºBrix sugar) with 7.40 and the minimum

was recorded in T_0 (Control) with 6.40. The decreasing trend was observed for flavour, Color and appearance and texture with increase storage period. This might be due to degradation of volatile substance and flavor constituents. Similar result was reported by **Nayak *et al.*, (2011)** in aonla segments-in-syrup prepared from stored fruits. **Jain *et al.* (2007)** in aonla RTS beverage. It could be attributed to non enzymatic reactions, which occur between nitrogenous compounds and sugars or organic acid and organic acids with sugars. Similar results were reported by **Syed *et al.* (2011)** in sweet orange based products.

The maximum score for Texture in cherry candy was recorded in T_2 (Application of $CaCl_2$ @1.5mg/100g + 70 ºBrix sugar) with 7.20 followed by T_7 (Application of Citric Acid @ 2mg/100g + 70 ºBrix sugar) with 7.40 and the minimum was recorded in T_0 (Control) with 6.40. The decreasing trend was observed for flavour, Texture and texture with increase storage period. This might be due to degradation of volatile substance and flavor constituents. Similar result was reported by **Nayak *et al.*, (2011)** in aonla segments-in-syrup prepared from stored fruits. **Jain *et al.* (2007)** in aonla RTS beverage. It could be attributed to non enzymatic reactions, which occur between nitrogenous compounds and sugars or organic acid and organic acids with sugars. Similar results were reported by **Syed *et al.* (2011)** in sweet orange based products.

The maximum score for Overall acceptability in cherry candy was recorded in T_2 (Application of $CaCl_2$ @1.5mg/100g + 70 ºBrix sugar) with 7.60 followed by T_7 (Application of Citric Acid @ 2mg/100g + 70 ºBrix sugar) with 7.40 and the minimum was recorded in T_0 (Control) with 6.50. The decreasing trend was observed for flavour, Overall acceptability with increase storage period. This might be due to degradation of volatile substance and flavor constituents. Similar result was reported by **Nayak *et al.*, (2011)** in aonla segments-in-syrup prepared from stored fruits. **Jain *et al.* (2007)** in aonla RTS beverage. It could be attributed to non enzymatic reactions, which occur between nitrogenous compounds and sugars or organic acid and organic acids with sugars. Similar results were reported by **Syed *et al.* (2011)** in sweet orange based products.

The maximum score for Aroma in cherry candy was recorded in T_2 (Application of $CaCl_2$ @1.5mg/100g + 70 ºBrix sugar) with 8.00 followed by T_7 (Application of Citric Acid @ 2mg/100g + 70 ºBrix sugar) with 7.80 and the minimum

was recorded in T_0 (Control) with 6.00. The increasing trend was observed for Aroma increase storage period. This might be due to production of volatile substance such as ethylene and flavor constituents. Similar result was reported by **Nayak *et al.*, (2011)** in aonla segments-in-syrup prepared from stored fruits. **Jain *et al.* (2007)** in aonla RTS beverage. It could be attributed to non enzymatic reactions, which occur between nitrogenous compounds and sugars or organic acid and organic acids with sugars. Similar results were reported by **Syed *et al.* (2011)** in sweet orange based products.

It is evident that the economics of different treatment was influenced by different treatments at all successive stage of storage. There was significant differences between the economics of treatments, among the treatment used T_2 (Application of $CaCl_2$ @1.5mg/100g + 70 ºBrix sugar) with 1.82 have the highest benefit cost ratio followed by T_7 (Application of Citric Acid @ 2mg/100g + 70 ºBrix sugar) with 1.69 of were significantly superior than T_0 (Control) with 1.42

Conclusion

On the basis of our experimental finding it was concluded that the treatment **T_2 (Application of $CaCl_2$ @1.5mg/100g + 70 ºBrix sugar)** was found to be best in the terms of Physico-chemical parameters, organoleptic evaluation and economic of the different treatments.

Future Scope

India is one of the most suitable countries in the world for growing fruit and vegetable throughout the year, this is due to factors such crop diversity, soil, manpower, technology, geographical and climatic conditions. But, at the same time, it is evident that 35-40% of produced fruits and vegetables are lost at postharvest stage due to improper harvesting, handling, marketing and storage practices. This postharvest loss can be overcome by adopting a scientific way of harvesting, post-harvest management and marketing. This creates a huge requirement for postharvest technologists in India. Postharvest technology (PHT) of horticultural crops is the field under which research and academics are undertaken to evolve skilled postharvest technologists. Demands for processed products and government attention towards postharvest losses paves way for the enormous scope and research inclination towards this sector.

Table 1 Effect of different treatments on TSS, Total sugar, Reducing sugar and Moisture content (%) of Cherry Candy.

Notion	Treatment	TSS (^{0}B)				Total Sugar (%)				Reducing sugar (%)				Moisture content %			
		Initial	30	60	90	Initial	30	60	90	Initial	30	60	90	Initial	30	60	90
T_0	Control	63.00	63.60	64.40	65.10	48.29	48.86	49.43	50.00	24.72	25.29	25.86	26.43	19.15	17.58	16.7	14.98
T_1	Application of $CaCl_2$ @1% +70 ºBrix sugar	63.90	64.00	64.60	65.10	48.63	49.20	49.77	50.34	25.06	25.63	26.2	26.77	19.53	17.96	17.08	15.36
T_2	Application of $CaCl_2$ @1.5% + 70 ºBrix sugar	65.00	65.50	66.00	66.90	50.21	50.78	51.35	51.92	26.64	27.21	27.78	28.35	20.55	19.50	18.62	16.90
T_3	Application of $CaCl_2$ @ 2%+ 70 ºBrix sugar	63.00	63.90	64.60	65.20	49.69	50.26	50.83	51.40	26.12	26.69	27.26	27.83	19.49	17.92	17.04	15.32
T_4	Application of Erythrosine @0.05%+ 70 ºBrix sugar	64.00	64.70	65.00	65.60	49.23	49.80	50.37	50.94	25.66	26.23	26.8	27.37	20.09	18.52	17.64	15.92
T_5	Application of Citric Acid @ 1%+ 70 ºBrix sugar	64.00	64.60	65.10	65.90	49.25	49.82	50.39	50.96	25.1	25.67	26.24	26.81	21.07	18.98	18.1	16.38
T_6	Application of Citric Acid @ 1.5%+ 70 ºBrix sugar	64.00	64.70	65.10	65.90	48.67	49.24	49.81	50.38	25.68	26.25	26.82	27.39	20.11	18.54	17.66	15.94
T_7	Application of Citric Acid @ 2% + 70 ºBrix sugar	65.00	65.20	65.90	66.30	49.82	50.39	50.96	51.53	26.25	26.82	27.39	27.96	20.68	19.11	18.23	16.51
	F Test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
	S. Ed. (±)	0.549	0.551	0.494	0.534	0.357	0.362	0.374	0.378	0.332	0.361	0.367	0.376	0.500	0.449	0.427	0.376
	C.D. at 5%	1.164	1.168	1.048	1.131	0.757	0.767	0.792	0.802	0.704	0.765	0.777	0.798	1.060	0.951	0.906	0.797
	CV	33.625	33.74	30.27	32.68	21.880	22.162	22.882	23.175	20.331	22.084	22.450	23.036	30.616	27.478	26.174	23.034

Table 2 Effect of different treatments on Ascorbic acid, pH, acidity % and score of Taste of Cherry Candy.

Notion	Treatment	Ascorbic acid (mg/100g)				pH				Acidity %				Taste			
		Initial	30	60	90	Initial	30	60	90	Initial	30	60	90	Initial	30	60	90
T_0	Control	160	155	151	145	3.44	3.52	3.62	3.72	0.32	0.28	0.21	0.15	7.80	7.50	7.00	6.50
T_1	Application of $CaCl_2$ @1% +70 ºBrix sugar	240	236	230	226	3.58	3.66	3.76	3.85	0.25	0.20	0.16	0.11	7.90	7.50	7.10	7.20
T_2	Application of $CaCl_2$ @1.5% + 70 ºBrix sugar	320	312	309	304	3.80	3.89	3.97	4.05	0.34	0.42	0.39	0.36	8.20	8.00	7.80	7.60
T_3	Application of $CaCl_2$ @ 2%+ 70 ºBrix sugar	240	232	226	221	3.71	3.80	3.90	3.98	0.44	0.41	0.38	0.31	7.90	7.60	7.10	6.80
T_4	Application of Erythrosine @0.05%+ 70 ºBrix sugar	160	155	150	146	3.62	3.69	3.79	3.88	0.38	0.34	0.28	0.24	7.80	7.50	7.00	7.20
T_5	Application of Citric Acid @ 1%+ 70 ºBrix sugar	160	154	151	145	3.69	3.79	3.89	3.98	0.38	0.34	0.29	0.27	8.00	7.60	7.20	6.80
T_6	Application of Citric Acid @ 1.5%+ 70 ºBrix sugar	240	235	230	224	3.62	3.70	3.80	3.89	0.38	0.34	0.30	0.26	8.00	7.80	7.50	7.10
T_7	Application of Citric Acid @ 2% + 70 ºBrix sugar	240	236	231	224	3.76	3.84	3.94	4.03	0.38	0.32	0.30	0.27	8.10	7.80	7.60	7.40
	F Test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
	S. Ed. (±)	0.621	0.590	0.559	0.356	0.421	0.423	0.433	0.412	0.016	0.010	0.010	0.010	0.120	0.134	0.179	0.117
	C.D. at 5%	1.316	1.250	1.184	0.755	0.097	0.097	0.097	0.093	0.034	0.020	0.021	0.020	0.254	0.285	0.379	0.247
	CV	38.010	36.115	34.207	21.800	0.206	0.206	0.205	0.196	0.982	0.587	0.602	0.586	7.328	8.236	10.935	7.135

Table 3 Effect of different treatments on score of Color and appearance, texture, overall acceptability, aroma and B:C ratio of Cherry Candy.

Notion	Treatment	Color and appearance				Texture				Overall acceptability				Aroma				B:C
		Initial	30	60	90	Initial	30	60	90	Initial	30	60	90	Initial	30	60	90	
T_0	Control	7.00	6.90	6.80	6.40	7.00	6.80	6.70	6.40	7.80	7.50	7.00	6.50	5.50	5.60	5.70	6.00	1.42
T_1	Application of $CaCl_2$ @1% +70 ºBrix sugar	7.50	6.90	6.80	6.60	7.20	7.00	6.80	6.70	7.90	7.50	7.10	7.20	6.00	6.20	6.40	6.60	1.55
T_2	Application of $CaCl_2$ @1.5% + 70 ºBrix sugar	8.00	7.80	7.62	7.50	8.00	7.90	7.80	7.60	8.20	8.00	7.80	7.60	7.50	7.70	7.80	8.00	1.82
T_3	Application of $CaCl_2$ @ 2%+ 70 ºBrix sugar	7.10	7.70	7.50	7.30	7.20	7.00	6.90	6.50	7.90	7.60	7.10	6.80	6.80	7.00	7.20	7.40	1.54
T_4	Application of Erythrosine @0.05%+ 70 ºBrix sugar	7.30	6.90	6.70	6.50	7.70	7.50	7.20	7.00	7.80	7.50	7.00	7.20	5.70	5.80	6.00	6.20	1.54
T_5	Application of Citric Acid @ 1%+ 70 ºBrix sugar	7.40	7.20	7.10	7.00	7.50	7.30	7.20	7.00	8.00	7.60	7.20	6.80	6.60	6.80	7.00	7.20	1.55
T_6	Application of Citric Acid @ 1.5%+ 70 ºBrix sugar	7.70	7.30	6.80	6.70	7.90	7.80	7.30	7.10	8.00	7.80	7.50	7.10	6.40	6.50	6.80	7.10	1.55
T_7	Application of Citric Acid @ 2% + 70 ºBrix sugar	7.30	7.70	7.50	7.40	7.80	7.50	7.30	7.20	8.10	7.80	7.60	7.40	7.30	7.50	7.60	7.80	1.69
	F Test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
	S. Ed. (±)	0.120	0.134	0.179	0.117	0.120	0.134	0.179	0.117	0.120	0.134	0.179	0.117	0.381	0.391	0.400	0.429	
	C.D. at 5%	0.254	0.285	0.379	0.247	0.254	0.285	0.379	0.247	0.254	0.285	0.379	0.247	0.807	0.829	0.849	0.910	
	CV	7.328	8.236	10.935	7.135	7.328	8.236	10.935	7.135	7.328	8.236	10.935	7.135	23.317	23.937	24.520	26.273	

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