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Research Article

Effect of heat and chemical preservatives on the overall quality of Muskmelon cubes preserved in sucrose solution

Haris Bilal[1*], Yasser Durrani[1], Majid Suhail Hashmi[1],Ali Muhammad[1], Muhammad Noor uddin[1], Qaiser Ali Sultan[1] and Mukhtar Ud Din[2]

1. Department of Food Science and Technology,The University of Agriculture Peshawar-Pakistan
2. Department of Human Nutrition,The University of Agriculture Peshawar-Pakistan
**Corresponding author's email:HarisBilal70@gmail.com*

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Abstract

This research was conducted to examine sucrose solution effect with selected food chemical preservatives potassium metabisulfite (PMS) and potassium sorbate (PS) on overall quality of the muskmelon cubes in sealed plastic jars and kept at ambient temperature.The importance of this study was to inhance the storage life of muskmelon fruit because alot of muskmelon goes surplus during the peak season. These treatments were analyzed physico-chemically (pH, titratable acidity, ascorbic acid, TSS, reducing sugar and non-reducing sugar) and organoleptically (texture, color, flavor and overall acceptability) at 15 days of interval for 90 days. Storage results showed that decreased was found in pH (6.10 to 5.43), ascorbic acid (35.18 to 18.39 mg/100g) and non-reducing sugar (14.04 to 11.95%). Similarly decrease in score rate was found for overall acceptability (8.20 to 7.60). An increase was found in muskmelon cubes for titratable acidity (0.08 to 0.14 %), TSS (18.40 to 22.54^{o} Brix) and reducing sugar (4.23 to 5.84%) during three months of storage. Statistical results revealed that treatment T_5 was found the best for overall quality (texture, color, flavor and nutritive stability) of muskmelon cubes preserved in sucrose solution and treated with chemical food preservatives followed by T_2, T_7, T_4, T_6 and T_3 respectively for all aspects.

Keywords: Chemical preservatives; Muskmelon cubes; Sucrose solution; Sensory analysis

Introduction

The economy of Pakistan is mostly dependent on the agriculture sector. This country climatic environment is also most suitable for the cultivation of various kinds of fruits and vegetables. Several kinds of well-known vegetables and fruits are grown here in the four seasons of the year **[1]**. Due to the awareness in the public about the nutritional importance of fruits in their diet, the demand for the fruits and their processed fruits products is gradually increasing. One of these fruits which are abundantly grown in the province of KPK is muskmelon. Various types of muskmelon are grown which are different in color and taste depend on its variety and climatic conditions of the area where it had been grown. Muskmelon relates to Cucurbitaceous family and *Cucumuis* (muskmelon) is known as sweet melon **[2]**.

Muskmelom is one of the more consumed fruit in the world [3]. In Pakistan the total area under cultivation for muskmelon is 48319 hectare with a productionrate723868 tones (F/V and condiments statistic of Pakistan, [4].

[5] Reported that maillard browning of glycine-glucose reaction (pH 5.5) was increased with sorbic acid. Acid-base catalysis is also involved in some browning. In food maillard bowning is also controlled by sulphur dioxide and it salts it's a good way or strategy to control it.[6] Found that browning due to proteins-glucose as well as sorbic acid was reduced up to 30%. To inhibit non enzymatic browning SO_2 can be used, enzyme catalyzed reactions can be inhibited, microorganisms can be controlled and it can also act as an antioxidant and reducing agent [7]. Sorbic acid E200 is a straight chain α, β unsaturated trans-trans 2, 4-hexadienoic monocarboxylic aliphatic acid and has the molecular formula CH_3-CH=CH-CH=CH-COOH (C_6 H_8 O_6). In water at 25^{o}C the solubility of sorbic acid is 0.16% and of potassium sorbate over 50%. Solubility in water increases with pH and temperature. Increased concentrations more than 10% of emulsified food items with glucose, sucrose, and sodium chloride reduce the sorbates solubility in water. Enzymes are complicated organic compounds which play a role as catalyst which make the synthetical changes. Different microorganisms are also bringing spoilage of foods. They can be controlled by heat and antimicrobials additives [8].Due to lack of proper preservation facilities and poor market system in our country large quantity of our fruits especially muskmelon fruit abundantly grown in KPK is wasted and ultimately a big income losses to farmers as well as to our national economy [9]. Muskmelon fruit is abundantly grown in the KPK province of Pakistan. In the peak season the surplus product of muskmelon is sold at cheaper rates because the growers are afraid that their product will be wasted due to costly and limited cold storages and other preservation facilities in the province. In this research proposal the muskmelon cubes were preserved in sucrose solution and treated with selected chemical preservatives.

Materials and methods

Fresh and good quality of muskmelon fruit (Honey-Dew variety) was selected for this study. The required quantity of muskmelon was purchased from Peshawar fruit market and used for the research treatments. The research work was conducted in the Department of Food Science & Technology, Faculty of Nutrition Sciences, The University of Agriculture Peshawar.

Washing

The muskmelons were properly washed with pressurized tap water to remove dust, insecticides, pesticides and other extraneous materials present on the muskmelon. After washing the healthy, defect free and matured sweetened muskmelons were selected for the preparation of research treatments.

Preparation of muskmelon cubes

Muskmelons were cut vertically in four pieces (from top to bottom). After coring the cut pieces were then peeled with the help of stainless steel knife. The muskmelon pieces were transferred to a stainless steel kettle which containing sterilized cool tap water containing 0.2% citric acid. The pieces were dipped in the solution so to prevent non-enzymatic browning due to oxidation. The muskmelon was then cut in uniform cube shaped in square inch pieces. Blanching of the required amount of muskmelon cubes for the number of treatments was carried out in water at boiling temperature for 4 to 5 minutes to inactivate the enzymes of catalase and peroxidase which are responsible for enzymatic browning of the fruit.

Proposed plan of the research

The treatments samples were packed in transparent plastic jars containing sucrose solution 30^0brix and then properly closed

with jars caps. The samples were stored at ambient temperature.

To: Unblanched Muskmelon cubes +30^0 brix Sucrose solution.

T1: Blanched Muskmelon cubes +30^0 brix Sucrose solution.

T2: Unblanched Muskmelon cubes +Sucrose solution 30^0 brix +0.1% Potassium metabisulphite

T3: Unblanched Muskmelon cubes +Sucrose solution 30^0 brix +0.1% potassium sorbate

T4: Unblanched Muskmelon cubes +Sucrose solution 30^0 brix +0.05% Potassium metabisulphite+0.05% potassium sorbate

T5: Blanched Muskmelon cubes +Sucrose solution 30^0 brix +0.1% Potassium metabisulphite

T6: Blanched Muskmelon cubes +Sucrose solution 30^0 brix +0.1% potassium sorbate

T7: Blanched Muskmelon cubes +Sucrose 30^0 brix +0.05% Potassium metabisulphite +0.05% potassium sorbate

Physicochemical analysis

The jars were sealed and stored at room temperature for shelf life study and overall quality evaluation of muskmelon cubes. The storage effect on physicochemical criterion (pH, TSS, acidity ascorbic acid, non-reducing sugars and reducing sugars) were analyzed by Lane and Eynon method **[10]**.

Sensory evaluation

The samples of muskmelon cubes preserved in sucrose solution were sensory calculated for texture, color, flavor and over all acceptability by the panel of 10 judges. Organoleptic study was carried out for each 15days interval for 90 days of storage. The evaluation was conducted by using9 point hedonic scale of **[11]**.

Statistical analysis

All the data including storage and treatments intervals was statistically calculated by means of completely Randomized Design (CRD) 2 Factorial as endorsed by **[12]** and means was separated by applying (LSD) Test at 5% possibility level as defined by Steel and Torrie **[13].**

Results and discussion

Physicochemical analysis

The statistical result showed that storage interval and treatments has a significant ($P< 0.05$) effect over pH value of muskmelon cubes in the entire three months of storage. (Table1).The mean values for pH were significantly ($P< 0.05$) decreased from pH 6.10 to 5.43 during ninety days of storing period. High mean values was noticed at treatment T_5 (6.04) and the lesser mean value was found T_0 (4.73). Similarly **[14]** during osmotic de-hydration and re-hydration attributes of pineapple slices a decrease was noticed in pH values.

The results acknowledged by statistics are that storage interval and treatments had a significantly ($P< 0.05$) effected on the percent-acidity of the muskmelon cubes preserved in sucrose solution. The mean values of % acidity significantly ($P < 0.05$) increased from 0.08% to 0.14%. High mean values were observed for treatment T_0 (0.14) while the lowest mean value was observed in treatments T_2, T_5, T_7 and (0.08) T_0 respectively. Maximum increase was found in T_0 (63.14%)and minimum in T_2, T_5 and T_7 (22.22%)as shown in (Table 2).Same results were considered by **[15]** in osmotically vacuumed dried mango slice.

The statistical results showed storage interval and treatments had a significant ($P< 0.05$) influence on the total soluble solids of the muskmelon cubes preserved in sucrose solution and stored for three months at ambient temperature (Table3). The mean values of TSS significantly ($P < 0.05$) increased from 18.40 to 22.54degree brix. High average mean values of TSS degree brix were observed in treatment T_5 (21.27) while the lowest average mean value of degree brix was found in treatment T_0 (19.76) respectively. The maximum percent increase in TSS was found in T_0 (23.28%) and

minimum in T_0 (8.42 %) respectively as shown in (Table 3).Same results were observed [15] of vacuumed de hydrated mango slices. In mandarin's slices a boost in solids soluble content was noticed [16].Our results are also in consolidation with [17] who found the boost in TSS of apple pulp conserved with food additives during storage. The statistical results revealed that storage interval and treatments significantly ($P< 0.05$) influenced ascorbic acid reduction of muskmelon cubes stored at ambient temperature (Table 4). The mean values of ascorbic acid content were significantly ($P< 0.05$) decreased from 35.18 to 18.39 mg/100g during storage. Highest average mean value for treatment was found in T_2 (30.58mg/100g) while lowest mean value was found in T_0 (25.87mg/100g). Low decrease was observed in T_6 (38.91 %) while maximum percent decrease was found in T_0 (67.12 %) as shown in (Table 4). [18] Reported regarding the preservation of apple juice with selected chemical preservatives and found the decline in vit-c in storage at ambient temperature.

The results acknowledged by statistics are that treatments and storage interval has a significant ($P< 0.05$) effect on reducing sugar of muskmelon cubes during three months of storage. (Table 5).The mean values of the treatment for reducing sugar significantly ($P< 0.05$) inclined from 4.23 to 5.84 % in three months of cache period. High average mean value for treatment was determined in T_4 andT_7 (5.26%) while lowest mean value for treatment was observed T_3 (4.7%) respectively. Maximum increase at three months storage as compared to initial amount reducing sugar of muskmelon cubes was found in T_7 (34.06 %) while minimum increased in treatment T_0 (14.29%)respectively as shown in (Table 5).[19] Studied juice products which were treated with various chemical additives and sucrose additive. [16] Also show same result in pine apple slices osmo-dehydration.

The results acknowledged by statistics are that storage interval and treatments had a significant ($P<0.05$) effect on non-reducing sugar of the muskmelon cubes during storage (Table 6).The mean values for non-reducing sugars was significantly ($P< 0.05$) decreased from 14.04% to 121.95% during storage. The highest mean value was noticed in T_5 (13.52) while minimum mean value was noticed in T_1 (12.80). Maximum percent-reduction in non-reducing take place in T_0 (21.68%) while minimum in T_7 (8.5) as shown in (Table 6). [20] Noticed same decrease in non-reducing sugar of sucrose to glucose and fructose used for muskmelon cubes preservation. [19] Found as same results for juice preservation treated with chemical-preservatives.

Organoleptic evaluation of muskmelon cubes

The sensory analysis taken place with the help of Larmond scale (hedonic 9 points) through 15 trained judges' panel they have experience for testing food samples through organoleptically evaluation.

The results that are acknowledged by the statistics is that repository interval and treatments has a significant ($P< 0.05$) effect on muskmelon cubes during repository and on its overall acceptability (got by color, flavor and texture) of Muskmelon Cubes(Table 7).The mean values of muskmelon cubes were significantly ($P< 0.05$) decreased from 7.85 to 6.30 during three months of repository. The maximum mean value of muskmelon cubes for overall acceptability was found in T_7 (7.86) while minimum in T_0 (5.43) as shown in (Table 7)**.** These results are supported by [21] who notices decrease on the overall acceptability of osmo-dehydrated slices of mangoes with inverted sugar sucrose and syrups. The conclusion is interlinked with [22] over all acceptability was reduced in apple slice.

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Table 1. Effect of selected chemical preservatives on pH of muskmelon cubes preserved in sucrose solution and stored at ambient temperature

Treat	Storage Interval							% Dec	Mean
	initial	15	30	45	60	75	90		
pH of Muskmelon Cubes									
T_0	6.02	5.82	5.45	5.42	5.04	4.81	4.73	21.43	5.33c±0.49
T_1	6.05	6.0	6.0	5.30	4.88	4.90	4.82	20.33	5.4c±0.57
T_2	6.15	6.10	6.08	6.01	5.95	5.85	5.75	7.32	5.98a±0.15
T_3	6.08	6.00	5.90	5.72	5.45	5.30	5.11	12.71	5.72b±0.28
T_4	6.16	6.08	6.05	6.00	5.92	5.88	5.78	7.31	5.97a±0.14
T_5	6.14	6.14	6.11	6.06	6.05	5.96	5.85	5.54	6.04a±0.12
T_6	6.10	6.05	6.00	5.82	5.65	5.53	5.44	8.36	5.85ab±0.20
T_7	6.11	6.10	6.08	6.00	5.92	5.88	5.78	5.40	5.98a±0.12
Mean	6.10a± 0.05	6.04a± 0.10	5.96ab± 0.21	5.79bc± 0.29	5.65cd± 0.44	5.55de± 0.45	5.43e± 0.43		

Values having different alphabetical letters are significantly (P<0.05) different

Table 2. Effect of selected chemical preservatives on Titratable Acidity of muskmelon cubes preserved in sucrose solution and stored at ambient temperature

Treat	Storage Interval							% Inc	Mean
	initial	15	30	45	60	75	90		
% Titratable Acidity of Muskmelon Cubes									
T_0	0.08	0.09	0.10	0.12	0.15	0.20	0.22	63.64	0.14a±0.05
T_1	0.08	0.08	0.08	0.11	0.18	0.15	0.18	55.56	0.12ab±0.04
T_2	0.07	0.07	0.08	0.08	0.09	0.09	0.09	22.22	0.08d±8.99
T_3	0.08	0.08	0.07	0.18	0.12	0.11	0.15	46.67	0.11abc±0.04
T_4	0.07	0.07	0.07	0.09	0.10	0.11	0.12	41.67	0.09cd±0.02
T_5	0.07	0.07	0.08	0.08	0.08	0.09	0.09	22.22	0.08d±8.16
T_6	0.08	0.08	0.07	0.09	0.10	0.13	0.16	50.00	0.10cd±0.03
T_7	0.07	0.08	0.08	0.08	0.08	0.09	0.09	22.22	0.08d±6.90
Mean	0.08c± 5.34	0.08c± 7.07	0.08c± 9.91	0.10b± 0.03	0.11b± 0.03	0.12ab± 0.03	0.14a± 0.04		

Values having different alphabetical letters are significantly (P<0.05) different

Table 3. Effect of selected chemical preservatives on TSS (ºBrix) of muskmelon cubes preserved in sucrose solution and stored at ambient temperature

Treat	Storage Interval							% Inc	Mean
	initial	15	30	45	60	75	90		
TSS (^{0}Brix) of Muskmelon Cubes									
T_o	18.50	19.40	20.00	21.20	19.00	20.00	20.20	8.42	19.76b±0.88
T_1	17.80	19.30	20.10	21.15	21.00	22.50	23.20	23.28	20.72a±1.85
T_2	18.60	20.20	20.50	21.10	22.20	22.50	23.10	19.48	21.17a±1.55
T_3	18.70	20.20	21.50	21.70	22.80	21.00	21.30	16.14	21.21a±1.30
T_4	18.60	20.00	20.40	21.60	21.82	22.00	23.80	21.85	21.17a±1.67
T_5	18.30	20.30	20.80	21.80	22.20	23.00	23.20	20.09	21.27a±1.61
T_6	18.40	20.00	20.10	21.10	21.20	22.10	22.00	17.49	20.74a±1.35
T_7	18.30	20.00	20.20	20.40	22.00	22.20	23.00	18.67	20.80a±1.51
Mean	18.40d± 0.28	19.93c± 0.37	20.45c± 0.49	21.26b± 0.44	21.42b± 1.06	22.01a± 0.84	22.54a± 1.07		

Values having different alphabetical letters are significantly (P<0.05) different

Table 4. Effect of selected of chemical preservatives on Ascorbic Acid (mg/100g) of muskmelon cubes preserved in sucrose solution and stored at ambient temperature

Treat	Storage Interval							% Dec	Mean
	initial	15	30	45	60	75	90		
Ascorbic acid (Vitamin-C) mg/100g of Muskmelon Cubes									
T_o	36.50	34.80	32.00	30.30	20.42	15.06	12.00	67.12	25.87d±9.90
T_1	34.00	32.80	30.12	27.80	24.90	21.20	16.32	52.00	26.73cd±6.38
T_2	37.20	35.80	33.32	31.78	28.70	25.55	21.70	41.67	30.58a±5.59
T_3	36.20	34.70	32.20	29.31	25.40	22.11	19.12	47.18	28.43bc±6.46
T_4	37.00	34.40	31.80	28.50	26.70	22.40	19.78	46.54	28.65b±6.24
T_5	33.40	31.35	28.80	25.40	22.20	20.65	18.12	45.75	25.70d±5.71
T_6	34.00	32.40	30.24	28.80	25.60	23.50	20.77	38.91	27.90bc±4.81
T_7	33.10	31.27	29.44	27.90	24.88	21.60	19.33	41.60	26.79bcd±5.07
Mean	35.18± 1.70	33.44± 1.71	30.99± 1.56	28.72± 1.88	24.85± 2.55	21.51± 3.02	18.39± 3.05		

Values having different alphabetical letters are significantly (P<0.05) different

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Table 5. Effect of selected chemical preservatives on Reducing Sugar (%) of muskmelon cubes preserved in sucrose solution and stored at ambient temperature

Treat	Storage Interval							% Inc	Mean
	initial	15	30	45	60	75	90		
Reducing sugar (%) of Muskmelon Cubes									
T_o	4.20	4.50	5.20	5.80	5.40	5.30	4.90	14.29	5.04abc±0.75
T_1	4.10	4.51	4.70	4.88	5.06	5.13	5.88	30.27	4.89c±0.75
T_2	4.30	4.51	4.78	4.88	5.05	5.50	6.10	29.51	5.04abc±0.75
T_3	4.25	4.10	4.67	4.86	5.12	5.23	5.12	16.99	4.76c±0.75
T_4	4.18	4.52	4.86	5.34	5.80	5.95	6.20	32.58	5.26a±0.75
T_5	4.35	4.30	4.82	5.12	5.55	5.90	6.30	30.95	5.19ab±0.75
T_6	4.23	4.11	4.61	4.90	5.15	5.65	5.80	27.07	4.92bc±0.75
T_7	4.22	4.60	4.96	5.20	5.53	5.90	6.40	34.06	5.26a±0.75
Mean	4.23e± 0.26	4.39e± 0.25	4.83d± 0.26	5.12c± 0.25	5.33c± 0.26	5.57ab± 0.25	5.84a± 0.26		

Values having different alphabetical letters are significantly (P<0.05) different

Table 6. Effect of selected chemical preservatives on Non-Reducing Sugar (%) of muskmelon cubes preserved in sucrose solution and stored at ambient temperature

Treat	Storage Interval							% Dec	Mean
	initial	15	30	45	60	75	90		
Non-Reducing sugar (%) of Muskmelon Cubes									
T_o	14.30	14.00	13.80	13.50	13.00	12.35	11.20	21.68	13.16b±0.75
T_1	13.75	13.72	13.60	13.20	12.50	11.50	11.00	20.00	12.80d±0.75
T_2	14.30	14.01	14.00	13.45	13.05	12.60	12.13	15.17	13.36a±0.75
T_3	14.05	13.90	13.48	13.05	12.34	12.00	11.85	15.66	12.95c±0.75
T_4	14.10	14.00	13.70	13.34	13.15	13.00	12.00	14.89	13.33a±0.75
T_5	14.02	14.03	13.95	13.50	13.34	13.10	12.70	9.42	13.52a±0.75
T_6	13.80	13.50	13.35	13.00	12.78	12.37	11.80	14.49	12.94c±0.75
T_7	14.03	14.00	13.80	13.40	13.25	13.00	12.90	8.05	13.18a±0.75
Mean	13.04a± 0.26	13.90b± 0.26	13.71b± 0.26	13.31c± 0.26	12.99d± 0.26	12.49e± 0.26	11.95f± 0.26		

Values having different alphabetical letters are significantly (P<0.05) different

Table 7. Effect of selected chemical preservatives on the Overall Acceptability (sensory evaluated) of muskmelon cubes preserved in sucrose solution and stored at ambient temperature

Treat	Storage Interval							% Dec	Mean
	initial	15	30	45	60	75	90		
Overall Acceptability score rate of Muskmelon Cubes									
T_o	7.00	7.00	6.00	5.50	5.00	4.00	3.50	50.00	5.43e±1.36
T_1	7.60	7.50	7.30	7.00	6.50	6.00	5.50	27.63	6.77cd±0.79
T_2	8.50	8.30	8.00	7.50	7.50	7.40	7.40	12.94	7.80a±0.46
T_3	7.50	7.40	7.20	7.00	6.80	6.00	5.00	33.33	6.70d±0.90
T_4	8.00	8.00	7.80	7.60	7.40	7.20	7.20	10.00	7.60ab±0.34
T_5	8.20	8.20	8.20	8.00	8.00	7.80	7.80	4.88	8.03a±0.17
T_6	7.80	7.80	7.70	7.60	6.60	6.50	6.40	17.95	7.20bc±0.66
T_7	8.20	8.00	8.00	7.80	7.80	7.60	7.60	7.32	7.86a±0.22
Mean	7.85a± 0.47	7.78a± 0.44	7.53ab± 0.70	7.25bc± 0.78	6.95cd± 0.96	6.56de± 1.24	6.30e± 1.51		

Values having different alphabetical letters are significantly (P<0.05) different

Conclusion

In the present research study muskmelon cubes were preserved in 30 º brix sucrose solution and treated with selected chemical preservatives of potassium metabisulfite and potassium sorbate with individual doses and combined doses. The samples were sealed in plastic jars and stored at room temp for ninety days. These research samples were analyzed physicochemically and organoleptically at each fifteens days of three months storage. Treatments where the muskmelon cubes were blanched and preserved with only potassium metabisulfite or combined dose of potassium metabisulfite and potassium sorbate showed best results physicochemically and organoleptically. The muskmelon cubes which were preserved with individual dose of potassium sorbate developed browning color in muskmelon cubes. Our conclusion shows that treatment T_7 (muskmelon cubes which were blanched and preserved in sucrose solution with combined chemical preservatives of potassium metabisulfite and potassium sorbate) was found the best for overall quality of muskmelon preservation.

Authors' contributions

Conceived and designed the experiments: H Bilal & Y Durrani, Performed the experiments: H Bilal, Analyzed the data: H Bilal, Contributed reagents/ materials/ analysis tools: YDurrani, MS Hashmi, A Muhammad, MN Din, QA Sultan, Wrote the paper: MU Din & H Bilal.

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