Effect of Sucrose Solution and Chemical Preservatives on Overall Quality of Strawberry Fruit

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Abstract

This research work was conducted to study the effect of sucrose solution with different chemical preservatives on overall quality of the strawberry fruit kept at ambient temperature. The treatments were: S0 (Control), S1 (Strawberry fruit + sucrose solution (30o brix) + Sodium benzoate 0.1%), S2 (Strawberry fruit + sucrose solution (30o brix) + Potassium sorbate 0.1%), S3 (Strawberry fruit + sucrose solution (40o brix) + Sodium benzoate 0.1%), S4 (Strawberry fruit + sucrose solution (40o brix) + Potassium sorbate 0.1%), S5 (Strawberry fruit + sucrose solution (30o brix) + Sodium benzoate 0.05% + Potassium sorbate 0.05%), S6 (Strawberry fruit + sucrose solution (40o brix) + Sodium benzoate 0.05% + Potassium sorbate 0.05%). All these treatments were examined physicochemically (Titratable acidity, pH, ascorbic acid, TSS, reducing and non-reducing sugar) and organoleptically (Texture, flavor, color and overall acceptability) at each 15 days interval for three months. Storage results shown that Decreased was found in pH from (3.49 to 3.32), ascorbic acid from (54.82 to 30.08 mg/100 g), reducing sugar from (20.41 to 13.36%), color score from (9 to 4.96), texture score from (9 to 5.14), flavor score from (9 to 5.23) and overall acceptability score from (9 to 5.40) while increased were found in TSS from (17.17 to 21.01oBrix), titratable acidity from (0.38 to 0.53%) and reducing sugar from (8.35 to 11.16%) throughout storage period. The highest mean value for pH was occurred in treatment S1 (3.45), titratable acidity in S3 (0.50%), TSS in S6 (24.76oBrix), ascorbic acid in S5 (46.30mg/100g), reducing sugar in S6 (11.69%), non-reducing sugar in S1 (19.65%), color in S5 (7.60), texture in S1 and S5 (7.46), flavor in S3 and S5 (7.60) and overall acceptability in S2 (7.83). Statistical results revealed that treatment S5 followed by S1 were found adequate both physicochemically and organoleptically.

Keywords: Strawberry; Sorbate; Benzoate; Sucrose; Ambient temperature

Introduction

Strawberry (Fragaria Spp.) belongs to kingdom Plantae and herbaceous member of family "Rosaceae". Over six hundred varieties occur worldwide. Strawberry is one of the important fruit among the berries. Various strawberry species grow wild all over the world, but the cultivated strawberry is based upon two species Fragarin Chiloensis and Fragarin Verginiana. Hybrids between these two species were the precursor of all the present strawberry cultivars [2]. Strawberry crop is recently introduced in Pakistan; its production in Pakistan is very low as compared to other countries of the world where strawberries were grown. In Pakistan it is grown inside definite places of Punjab, Islamabad and Khyber Pakhtunkhwa [3]. There are many varieties grown in the world but the main promising varieties grown in Pakistan are Mission, Corona, Tuft, Sweet Charlie, Super faction and Festival. During 2009-10 strawberry was grown on an area of about 193 acres and its production was 274 tons in Pakistan [4]. According to Food and Agriculture Organization (FAO), world production of strawberries has exceeds 4 million tons, in which United States contributes 28 percent [5]. Nutritionally, One cup of strawberry contains 1g protein, 10.5 g carbohydrates, 0.6 gm fat, 1.6 gm fiber, 0.1 mg thiamin, 84.5 mg vitamin C, 26.4 mg folic acid, 0.1 mg riboflavin, 0.4 mg niacin, 0.2 mg zinc, 0.6 g iron, 2 g sodium, 21g calcium, 16 mg magnesium, 45 kcal calories. Vitamin C level of Strawberry fruit is more than oranges. Strawberry fruit also give an exceptional supply of vitamin K, vitamin B5, vitamin B6, manganese, magnesium, copper, potassium and omega 3 fatty acids (USDA, 2008) [6,7]. Malic and Citric acids are main organic acids which contribute to aroma. Strawberries also contain the higher percentage of non-nutrients e.g. phenols and flavonoids as compared to other berry fruit [8]. Strawberry fruit have juicy, tiny, flavorful, nourishing, syrupy flavor, diuretic, remineralizing, tonic and astringent attributes [9]. The strawberry fruit can be used both in fresh form and preserved to Jellies, James and squashes that can be consumed in off season [10]. Osmotic Dehydration (OD) is a technology that partially removes the water from fruits and vegetables, when it is dipped in a hypertonic solution of salt, sugar or others. This process is successfully applied to those fruit and vegetable, which is perishable and cannot be supplied to market in fresh form. However, OD is a pretreatment course of action so further is process is necessary for the stability of the product. Osmotische Dehydration Method (OD), also named dewatering and impregnation by immersion in concentrates or by immersion of fruits and vegetable in concentrated solutions or syrups of soluble solids, without phase change [11]. Sugar provides sweet taste and flavor to the product; they also provide freshens and contributes to the product quality [12]. Different chemical preservatives are used in food products to extend their shelf life but the most important are sodium benzoate, potassium sorbate, potassium metabisulphite, sorbic acid, sulphur dioxide etc. Potassium sorbate, retard yeasts and molds growth in numerous food stuffs like yogurt, cheese, wine, dried meats and dehydrated commodities. Sodium benzoate is a bacteriostatic and fungistic preservative underneath acidic environment and is mostly used in acidic foods like salad dressings (vinegar), carbonated munched (carbonic acid) and condiments [13]. Nonetheless, the future of strawberry production and processing might be very much bright in...
our country in general and Khyber Pakhtunkhwa in particular because this fruit fetches maximum economic returns for the farmer. Due to the perishability of strawberry fruit, this research work was designed to prepare a value added product from strawberry i.e. osmic-dehydrated product which will be available throughout the year in a market. The farmers will be benefitted while getting proper return for their produce.

Materials and Methods

Sound, healthy and ripened strawberries were purchased from the orchard at Charssadda and were brought to the laboratory of Food Technology section, Agriculture Research Institute, Tarnab Peshawar where research work was conducted. Strawberry fruit with decent texture and color were selected. After washing with cold water the stalks of the fruits were removed with stainless steel knives. Two different concentrations of sucrose solutions (30°Brix and 40°Brix) were prepared with supplementation of different chemical preservatives (Sodium benzoate and Potassium sorbate). The treatment were numbered as, S₀ (Control), S₁ (Strawberry fruit + sucrose solution (30° brix) + Sodium benzoate 0.1%), S₂ (Strawberry fruit + sucrose solution (30° brix) + Potassium sorbate 0.1%), S₃ (Strawberry fruit + sucrose solution (40° brix) + Sodium benzoate 0.1%), S₄ (Strawberry fruit + sucrose solution (40° brix) + Sodium benzoate 0.05% + Potassium sorbate 0.05%), S₅ (Strawberry fruit + sucrose solution (40° brix) + Sodium benzoate 0.05% + Potassium sorbate 0.05%), S₆ (Strawberry fruit + sucrose solution (40° brix) + Sodium benzoate 0.05% + Potassium sorbate 0.05%). The whole strawberry fruit were immersed in 500 ml sterilized plastic jars filled up with sucrose solution. For analysis and shelf life study, the jars were completely sealed and stored at ambient temperature.

Chemical analysis

Acidity, pH, Total soluble solids, reducing and non-reducing sugar, Ascorbic acid were evaluated through standard methods of AOAC (2012) [14].

Organoleptic analysis

Organoleptic analysis (flavor, color, texture and overall acceptability) was done by using Larmond scale [15] at an interval of 15 day for a total period of three months at room temperature.

Statistical analysis

All the data concerning treatments and storage interval were statistically analyzed by means of completely Randomized Design (CRD) 2 Factorial and the means were separated by applying Least Significant Difference (LSD) Test at 5% possibility level as defined by Steel and Torrie [16].

Results and Discussion

Chemical analysis

pH: pH of the fruit is mainly associated to the flavor and perishability. The mean pH values decrease during storage from 3.49 to 3.32 (Table 1). The highest percent decrease was found in S₀ (5.71%) followed by S₂ (5.20%) while the lowest percent decrease was observed in S₁ (3.99%) followed by S₅ (4.02%). The results are in agreement with the conclusions of Fasogbon et al. [17] who observed decrease in pH value during osmotic dehydration and rehydration characteristics of pineapple slices. A similar result in decreased of pH value in strawberry syrup was also reported by Khan [18] due to the development of acidic compounds.

Total soluble solid (TSS): The mean Total Soluble Solids of the treatments increase from 17.17 to 21.01 °brix during storage. Highest percent increase was found in S₀ (83.05) followed by S₅ (25.32) while lowest percent increase was observed in S₆ (16.0) followed by S₀ (21.25) as shown in Table 2. Similarly Kumar and Devi observed an increase in total soluble solid during osmo dehydration of pineapple slices.

Titratable acidity (%): Mean values for Titratable acidity increase from 0.38 to 0.53 during storage period (Table 3). The highest percent increase was observed in S₀ (31.63%), followed by S₅ (30.51%) while lowest percent increase was noted in S₁ (25.0 %), followed by S₅ (27.27 %) shown in Table 3. The results are in agreement with the conclusions of Ali et al. [19] who observed an increase in titratable acidity during preservation of persimmon slice. Similar results were investigated by Kumar et al. [20] in osmotically vacuumed dried mango slice. The increase in acidity might be due to development of acidic substances by the degradation of pectic bodies or breakdown or oxidation of reducing sugar into acid due to high temperature.

Ascorbic acid (mg/100 g): Ascorbic acid content decreased with the storage time. The mean values of ascorbic acid content were significantly decreased from 54.82 to 30.08 mg/100g during storage. Maximum percent decrease was found in S₅ (65.74%) followed by S₅ (49.10%), while minimum percent decrease was found in S₅ (32.93%) followed by S₅ (37.28%) shown in Table 4. These outcomes are in agreement with the conclusions of Kumar et al. who observed decreased in ascorbic acid content of osmo-vac dehydrated mango slices.

Reducing sugar: During storage interval amount of reducing sugars (Reducing sugars may be maintained under proper conditions quite stable at high temperature) gradually increased from 8.35 to 11.16. Maximum percent increase was found in S₀ (43.85%) followed by S₅ (32.18%) while minimum percent increase was found in S₅ (24.15%) followed by S₅ (26.31%) while control samples i.e. S₀ showed decrease during storage as shown in Table 5. Results showed that reducing sugar increased with time but the control decreased with time. These results are shown by Wisal et al. [21] during storage of strawberry juice with different chemical preservatives and sucrose content. Kumar et al. [22] also show similar results during pineapple slices osmo dehydration.

Non reducing sugar: The mean values of non-reducing sugar of strawberry fruit samples (S₀ to S₅) were decreased from 20.41 to 13.36 during storage duration. Highest percent reduction in non-reducing sugar was occurred in S₀ (91.40%) followed by S₅ (38.02%), while percent lowest reduction was recorded in S₅ (16.95%) followed by S₁ (21.43%) as shown in Table 6. Zia and Ayub [23] observed similar results in decreased in non-reducing sugar of sucrose and glucose preserved melon cubes. Wisal et al. reviewed similar results in strawberry juice preservation in different chemical and sucrose contents.

Sensory evaluation

Color: The initial average scoring rate of the Judges for color of strawberry fruits samples were 9.0, 9.0, 9.0, 9.0, 9.0, 9.0 and 9.0 which gradually decreased to 1.00, 6.10, 5.40, 5.70, 4.70, 6.50 and 5.30 respectively for total storage duration. The average mean values for strawberry fruits preserved were considerably (P<0.05) declined from 9.00 to 4.96 during storage period. The maximum mean value of strawberry preserve for color was S₅ (7.60) followed by S₁ (7.47) while minimum mean value for color was S₀ (4.13) followed by S₄ (6.39). Highest percent decreased in color occurred in S₀ (88.89 %) followed by S₄ (47.78 %) while percent lowest decreased in color occurred in S₅ (27.78 %) followed by S₁ (32.22 %) shown in Table 7. Moreno
et al. [24] observed color changes during ohmic heating, vacuum impregnation and osmo dehydration of strawberry fruits. Mancilla et al. [25] showed similar changes in color during osmo dehydration under hydrostatic pressure of strawberry fruits. The change in strawberry color is associated with chromatic coordinates which is affected by osmodeydration under hydrostatic pressure. Perera et al. [26] observed similar results of decrease in color due browning reaction (millard) that occurred throughout storage in pineapple juice. Kumar and Devi recorded decrease in color of pineapple slice throughout storage. Colors of mango chips were also affected by osmosedhydration by Zou et al. [27].

Texture: The initial score rate of the judges for texture of the strawberry fruit samples were 9.0, 9.0, 9.0, 9.0, 9.0, 9.0 and 9.0 which gradually decreased to 1.00, 6.10, 5.30, 5.80, 5.60, 5.90 respectively at total storage period. The average mean values for strawberry fruits preserved were considerably (P<0.05) declined from 9.0 to 5.14 during storage period. The higher mean value of strawberry fruit preserved for texture was found in S 1 and S5 (7.46) followed by S6.
(7.39) while lower mean value was observed in S0 (4.27) followed by S6 (4.61). Highest percent decreased in flavor score was observed in S0 (88.89%) followed by S4 (45.56%) while percent lowest decreased was observed in S5 (25.56%) followed by S7 (27.78%) shown in Table 9.

Similar results were also observed by Torres et al. [31] loss of aromatic occurred in osmo dehydration of mango and concluded that high osmorehydration level, effect the volatile compound negatively while lower osmorehydration level give rise to enhancement of the volatile profile. Pani et al. [32] observed degradative event during osmorehydration and air dehydration of tomato slices. Habib et al. [33] also observed decline in flavor mango. Osmotic treatments stimulated alterations in the volatile profile of mango were observed for strawberry by Escriche et al. and in kiwi by Talens et al. [34].

**Overall acceptability:** The mean score for overall acceptability of the strawberry fruit preserve decreased from 9.00 to 5.40. Highest percent decreased in overall acceptability was founded in S1 (88.89%) followed by S6 (46.67%), while the lowest percent decreased was observed in S3 (25.56%) followed by S4 (26.67%) as shown in Table 10. These results are in commerce with Sabrina et al. [35] who observed decline in the overall acceptability of osmo dehydrated mango slices with inverted sugar syrup and sucrose [36].
Conclusions and Recommendations

In this research study strawberry fruits were preserved using different concentration of sucrose solutions and chemical preservatives, stored in plastic jars at ambient temperature. It is concluded from the present research study that treatments S₅ (Strawberry fruit + sucrose solution (30 °brix) + Sodium benzoate 0.05% + Potassium sorbate 0.05%) followed by S₁ (Strawberry fruit + sucrose solution (30 °brix) + Sodium benzoate 0.1%) were found superior during physiochemical and organoleptic evaluation.

The evaluation of strawberry’s quality during storage in sugar solutions at 30 and 40 °brix with two different preservative agents at 2 different concentrations at room temperature (alone and combined). The physicochemical and organoleptic quality criteria are relevant.

Recommendation for further research work on this study:

1. The same study should be carried out in glass jars and in color jars.
2. Such study should be carried out at freezing and refrigeration temperature.
3. Further research work should be done at other sucrose concentration or other sweeteners.

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References


