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EFFECT OF NON-NUTRITIVE SWEETENERS, CHEMICAL PRESERVATIVES AND ANTIOXIDANTS ON MICROBIAL AND SENSORY CHARACTERISTICS OF DEHYDRATED GUAVA

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Abstract: A study was carried out to evaluate the effect of various concentrations of non nutritive sweeteners individually and in combination along with chemical preservatives i.e. potassium metabisulphite (PMS) and potassium sorbate (PS) and anti-oxidants including citric acid (CA) and ascorbic acid (AA) on microbial and sensory characteristics of dehydrated guava slices during 90 days storage. The solutions of saccharine, cyclamate, aspartame and their mixture were prepared in different concentrations. Guava slices were submerged in these sweeteners for a 24 hour and subsequently cabinet dehydrated to a final moisture content of 25%. Total microbial count (TMC) were recorded in all samples however, samples treated with AA, CA and PMS showed negligible microbial population than PS during storage. Guava slices treated with non-nutritive sweeteners were leathery in appearance due to severe loss of moisture. Comparatively the slices treated with PMS and AA showed highest overall acceptability. The statistical analysis showed that storage intervals and sweeteners had a significant effect ($p<0.05$) on TMC and organoleptic quality of dehydrated guava slices.

Introduction

Guava fruit is well characterized for its pleasant taste and flavor in all over the world. It is cultivated everywhere in Pakistan, due to suitability of soil, excellent climatic condition and availability of water. It has a distinct musky flavor, which is slightly reduced during processing. Guava contains 83%, moisture, 6.8% protein, 0.6% fat, 15% carbohydrate, 280 i.u. vit A, 266 mg/100g vit C, 0.53% citric acid, 0.09 mg iron, 42 mg phosphorus and 23 mg calcium (Gauhar and Durrani, 1972).

For the last few decades' people are using various non-nutritive sweeteners (NNS) (Mitchell and Pearson, 1991). Most sugar degrades into its two components i.e. dextrose and fructose in many products leading to a vast difference in flavor perception between the freshly prepared and the aged product. This difference in taste is often perceived as a difference in sweetness intensity and duration (Woodroof and Phillip, 1981). Among NNS saccharine, cyclamate and aspartame are most common in food items. Saccharine is 200 to 700 times sweeter than normal sugar; however, it can produce a bitter aftertaste and is often found in combination with other sugar in food items (Mitchell and Pearson, 1991). The Food Drug Administration for food safety and applied nutrition allowed its daily use of 50 mg per person per day or 5 mg/kg body wt. per day. It is approved for use in more than 100 countries (FAO/WHO, 1993). Cyclamate is more than 30 times sweeter than sucrose and is approved for use in more than 50 countries in all food items. Aspartame (also known as Nutra Sweet) is about 200 times sweeter than normal sugar (HHS, 2000). It is composed of two amino acids i.e. phenyl alanine and asparagic acid, and is used in all food items. It was discovered in 1965 and approved by FDA in 1981 in all dry foods (Warner-Vetsch, 1985).

Over-nutrition in the affluent countries and the ever-increasing diet consciousness of consumers has contributed to the growing market for low caloric foods. Low caloric foods and beverages generally are formulated through, use of NNS as substitutes for conventional sweeteners (i.e., sucrose). Substitution of conventional ingredients in food system by ingredients providing equivalent organoleptic attributes at a reduced solids level. Non nutritive ingredients play a significant role in the formulation of low caloric foods. The need for safe and acceptable nonnutritive sweeteners is pressing and challenging, especially to those formulating low-calorie foods. The demand for these foods has steadily increased over the last decade and is expected to become greater in the future availability and safety in foods.

Nutritive sweeteners cause major contribution towards many diseases therefore, this study was undertaken to prepare low caloric sweetened dehydrated guava slices using NNS. This intermediate moisture candy type product will be a ready made best food for diet conscious people of all ages and especially for diabetic patients. In this way the product will be efficiently utilized in peak season and the consumer will enjoy a sweetened product with reduced calories.

Materials and Methods

Sound healthy guavas of medium size and maturity were obtained from local market of Peshawar. The fruits were sliced (1-1.2 inch) and were kept in 2% CA solution to prevent their oxidation.

Preparation: The fruit slices were blanched in 0.25 % CA solution for 1 to 1.5 minutes at 100^0C to avoid possible enzymatic reactions. The fruit slices were cooled and drained of excess water. Fruit slices were kept in various sweeteners solutions of saccharine, aspartame, cyclamate and their mixture (N_0 to N_{24}, taken in mg with equal to the strength of 20, 30, 40 and 50^0 bx, of sucrose solution by using Pearson's equations) for 24 hours respectively. Preservatives @ 0.08 % (PMS and PS) and antioxidants @ 0.1% (CA and AA) were used during dehydration. Treatment plane is given in Table 1.

Dehydration: The fruit slices were dehydrated in microprocessor controlled oven to a moisture content of 20–25 % initially at 70^0C and then at 60^0C.

Table I. Proposed plan of study for research.

Treatments	Non nut. sweeteners	Anti oxidants	Preservatives
N_0	Saccharine	-	-
N_1	Saccharine	Citric acid	Potassium metabisulphite
N_2	Saccharine	Ascorbic acid	Potassium metabisulphite
N_3	Saccharine	Citric acid	Potassium sorbate
N_4	Saccharine	Ascorbic acid	Potassium sorbate
N_5	Cyclamate	-	-
N_6	Cyclamate	Citric acid	Potassium metabisulphite
N_7	Cyclamate	Ascorbic acid	Potassium metabisulphite
N_8	Cyclamate	Citric acid	Potassium sorbate
N_9	Cyclamate	Ascorbic acid	Potassium sorbate
N_{10}	Aspartame	-	-
N_{11}	Aspartame	Citric acid	Potassium metabisulphite
N_{12}	Aspartame	Ascorbic acid	Potassium metabisulphite
N_{13}	Aspartame	Citric acid	Potassium sorbate
N_{14}	Aspartame	Ascorbic acid	Potassium sorbate
N_{15}	Saccharine: aspartame	-	-
N_{16}	Saccharine: aspartame	Citric acid	Potassium metabisulphite
N_{17}	Saccharine: aspartame	Ascorbic acid	Potassium metabisulphite
N_{18}	Saccharine: aspartame	Citric acid	Potassium sorbate
N_{19}	Saccharine: aspartame	Ascorbic acid	Potassium sorbate
N_{20}	Saccharine: cyclamate	-	-
N_{21}	Saccharine: cyclamate	Citric acid	Potassium metabisulphite
N_{22}	Saccharine: cyclamate	Ascorbic acid	Potassium metabisulphite
N_{23}	Saccharine: cyclamate	Citric acid	Potassium sorbate
N_{24}	Saccharine: cyclamate	Ascorbic acid	Potassium sorbate

Total microbial count: Selected samples were analyzed for total fungal count by the total plate count method described by Diliello (1982).

Sensory evaluation: Samples were evaluated for color, flavor, texture and overall acceptability by a panel of fifteen judges using "9-Point Hedonic Scale" as described by Larmond (1977).

Statistical analysis: The results were analysed statistically by analysis of variance using Randomized Complete Block Design (Steel and Torrie, 1980), the means were separated by least significant difference test (Chochron and Cox, 1965).

Results and Discussion

Total Microbial Count (TMC): Result showed that the overall mean count increased from 2.04 cfu/g to 71.92 cfu/g during storage. Maximum increase in TMC was observed in sample N_4 followed by N_7, while minimum count was observed in sample N_{14} followed by $N_{13.}$ Maximum mean values were recorded in sample N_{10} followed by N_5 i.e. 58.86 and 57.43, while minimum mean values were recorded in sample N_{16} followed by N_{12} i.e. 22.86 and 23.86 cfu/g during storage (Table 2). Total count is an index of quality of intermediate moisture food, high count indicate too much contamination during handling and processing. The multiplication of microorganism in the products during storage impairs its quality. The presence of microorganisms in all samples and especially in controlled may be due to rough handling or due to reopening of packages during sensory evaluations in storage period. Yeasts and molds can grow in dehydrated product even at low moisture and low water activity (Beuchat, 1981). It is recommended that hermitically sealed aseptic individual pack must be used during sensory evaluation. Samples having PMS showed negligible microbial population compare to samples having PS. Brenndor et al. (1985) reported that addition of SO_2 in food commodities help in controlling microbial population compare to other samples. PS did not control the activity of microorganisms and therefore, cannot be recommended to use in all foods during processing (Warth, 1977).

Sensory evaluation: The overall mean score for color assigned by the panel of 15 judges significantly ($p<0.05$) decreased from 6.77 to 4.8 in all samples during storage. Maximum decrease was observed in sample N_2 followed by N_{14} i.e. 68.09 and 38.27%, while minimum decrease in color score was observed in sample N_1 followed by N_{13} i.e. 12.5 and 15.87 (Table 2). The fruits which added with PMS and AA maintain comparatively more natural color due to sulpher competition for amine group making a block against carbohydrates (Schroeter, 1966). Similarly SO_2 scavenges the hydrogen peroxide formed and keeps check further oxidation of the dehydroascorbic acid and other products. The SO_2 stabilizes the dehydroascorbic acid by reacting with the ketone bonds (Wisser et al., 1970) which stabilizes the color of the products. Shah et al. (1975) determined that guava products having SO_2 shows best results in maintaining color during storage.

Result regarding flavor of guava slices showed that the overall mean score significantly ($p<0.05$) decreased in all samples from 5.04 to 3.14 during storage. Maximum decrease in flavor score was observed in samples N_2 followed by N_1 i.e. 60 and 50%, while minimum decrease was observed in samples N_{20} followed by N_{17} i.e. 14.29 and 15.85% (Table 2).

Table 2. Overall acceptability of guava slices in non-nutritive sweeteners during storage

Days (→)	Fresh	15	30	45	60	75	90
TMC	2.04g	8.360f	24.24e	34.64d	45.24c	59.68b	71.92a
Color	6.77a	6.44b	6.14c	5.88d	5.60e	5.26f	4.80g
Flavor	5.96a	5.63b	5.33c	5.07d	4.82e	4.51f	4.16g
Texture	6.08a	5.82b	5.58c	5.32d	5.10e	4.86f	4.58g
Overall accp.	6.21a	5.96b	5.68c	5.42d	5.18e	4.87f	4.52g

Figures in rows with different small letters are significantly different ($p<0.05$)

The mean score for texture significantly ($p<0.05$) decreased in all samples from 6.08 to 4.54 during storage. Maximum decrease in texture score was observed in sample N_{11} followed by N_2 i.e. 44.44 and 35.9, while minimum decrease was observed in sample N_{10} followed by N_{24} i.e. 15.71 and 17.91%. The mean score for overall acceptability significantly ($p<0.05$) decreased in all sample from 6.21 to 4.52 during storage. Maximum decrease was observed in sample N_2 followed by N_0 i.e. 56.41 and 35.9%, while minimum in sample N_{24} followed by N_{23} i.e. 17.14 and 20%. For treatments maximum mean values were recorded in sample N_{17} followed by N_{19} (i.e., 7.51 and 6.82), while minimum in sample N_2 followed by N_0 (i.e., 2.78 and 3.21) (Table 2). Guava slices treated with NNS gave a product of poor quality and leathery in appearance due to severe losses of moisture during cabinet dehydration (Ayub et al., 1995).

Comparatively guava slices kept in mixture of NNS, PMS and AA obtained maximum mean scores due to the product natural color, flavor and texture. Browning was minimum in these products as sulpher compete for amine group making a block against carbohydrates (Schroeter, 1966). Similarly SO_2 scavenges the hydrogen peroxide formed and keeps and stop further oxidation of the dehydroascorbic acid. The SO_2 stabilizes the dehydroascorbic acid by reacting with the ketone bonds (Wisser et al., 1970) which stabilizes the overall appearance of the products. The analysis showed the treatments and storage intervals had a significant effect ($p<0.05$) on TMC, color, flavor, texture and overall acceptability of dehydrated guava slices.

Conclusion

Based on the above results it can be concluded that for the preparation of shelf stable dehydrated guava slices, mixture of non nutritive, PMS along with AA and CA is best combination for maintaining natural color, flavor, over all acceptability, maximums nutrients and minimum microbial population.

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