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Effect of Osmotic Agents on Intermediate Moisture Aonla Segments during Storage

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Abstract

Aonla (Phyllanthus emblica L.), a plant of Euphorbiaceae family, is one of the most important medicinal fruits available in North India and is, therefore, used as a major constituent in several Ayurvedic preparations. The intermediate moisture aonla segments cv. Banarasi were prepared by using three types of osmotic agents, 60 per cent sucrose, 60 per cent sucrose-glycerol (1:1) and 60 per cent glycerol. The moisture content and water activity of intermediate moisture aonla segments decreased significantly during six months storage. Total soluble solids (TSS) of IMF aonla segments increased significantly (37.9 to 48.9%), while ascorbic acid of IMF aonla segments decreased significantly (427 to 185 mg/100 g) during six months storage period. Maximum retention of ascorbic acid was recorded in intermediate moisture aonla segments when steeped in 60 per cent glycerol. Organoleptically 60 per cent sucrose treatment was evaluated most effective in maintaining the overall quality of the product followed by 60 per cent sucrose-glycerol (1:1) and 60 per cent glycerol.

Keywords: Intermediate moisture foods, aonla, osmotic agents, chemical parameters.

1. Introduction

Aonla is one of the oldest Indian fruits and considered as “Wonder fruit for health”. It is also known as Indian gooseberry, Amalaki, Amla, Amlet, Amolphal, Aovla, Aurna, Chukna, Dhatriphala, Emblic myrobalan, Nelli and Sobju in different parts of world

(Agarwal and Chopra, 2004). India ranks first in the world in area and production of aonla crop (Priya and Khatkar, 2013). It is a rich source of vitamin C and its content of ascorbic acid is next to only that of Barbados cherry. Aonla has been reported to be hepatoprotective and possesses expectorant, purgative, spasmolytic, antibacterial, hypoglycemic and hypolipidemic activities (Mishra *et al*, 2010).

The Intermediate Moisture Foods (IMF) are semi-moist foods that have some of their water bound by sucrose, glycerol, sorbitol, salt or certain organic acids for a short period of time, thus, preventing the growth of many microorganisms. In 1980s, the committee for IMF of France's National Center for Coordination of Research on Food and Nutrition proposed the definition for intermediate moisture foods: "food products of soft texture, subjected to one or more technological treatments, consumable without further preparation and with a shelf stability of several months, assured without thermal sterilization, nor freezing or refrigeration, but by an adequate adjustment of their formulation: composition, pH, additives and mainly a_w (activity of water) which must be approximately between 0.65 and 0.90 measured at 25^0 C. Generally, they contain moderate levels of moisture of the order of 20 to 50 per cent (Vora *et al*, 2003). The IM foods have an acceptable eating quality and reasonable storage stability under ambient conditions (Iman *et al*, 2011).

When food is available more than the present use, it is preserved for future consumption. Preserved food is easier to distribute and can be made available in all places at all time. Aonla fruits are available in plenty during peak harvesting season. Due to insufficient demand, weak infrastructure, poor transportation and perishable nature of aonla fruits, the farmers sustain substantial losses and do not get remunerative prices of their produce. The efforts made by researchers and processors are still lacking in developing processing techniques for making IMF aonla segments to meet out the growing demand of value added aonla products in domestic and export markets throughout the year. Keeping the above facts in view, the present research work was planned with the objectives to develop intermediate moisture aonla segments and also to evaluate its shelf life.

2. Experimental Methods

2.1 Preparation of Intermediate Moisture Aonla Segments

Mature aonla fruits cv. Banarasi were procured from the local orchard adjoining Hisar during December-January, 2011-2012. The fruits were washed thoroughly with clean running water, pricked using aonla pricking machine and steeped in 2 per cent brine solution for 2 days to remove astringency. The fruits were then dipped in alum solution (2%) for one day. After steeping, aonla fruits were blanched in boiling water containing 2 per cent potassium metabisulphite (KMS).

The sucrose and glycerol were used as osmotic agents. The osmotic syrups of 60^0Brix were prepared by mixing sucrose and glycerol with clean potable water on w/w basis. The aonla segments were steeped in three syrup solutions i.e., sucrose, sucrose+glycerol (1:1) and glycerol of 60^0Brix strength for 16 hours for osmosis. After

steeping, the segments were drained free of syrup, spread on aluminium trays and dried in a tray drier at 50^0C overnight to make an intermediate moisture food product. The IMF aonla segments were packed in LDPE bags and stored at room temperature for six months. The samples were analysed at monthly interval during storage.

2.2 Chemical Analysis

The intermediate moisture aonla segments were analysed for quality parameters. Moisture content was estimated by Dean and Stark method. Water activity (a_w) was analysed by using water activity meter (Labswift a_w, Novasina, Switzerland). Total soluble solids (%) were estimated at ambient temperature by Abbe's Refractometer (0-95%) or by hand refractometer (0-32%) (Erma, Japan). Ascorbic acid (mg/100g) was determined as per the method given by A.O.A.C. (1990).

3. Experimental Results

3.1 Chemical Analysis of Fresh Aonla Fruits

On fresh weight basis, the moisture content was found to be 85.6%. The moisture content of whole mature fruit was within the range (79.3-88.06%) as reported by Tripathi *et al* (1988). The total soluble solids of fresh aonla fruits were found to be 11.6 per cent and ascorbic acid content was analysed to be 609.28 mg/100 g. Teotia *et al* (1968) also reported values of total soluble solids between 9.0-15.0 per cent and of ascorbic acid in the range of 450-665 mg/100g.

3.2 Moisture content of Intermediate Moisture Aonla Segments During Storage

The moisture content decreased from 85.6 to 31.33 per cent during processing of aonla into IMF segments The moisture content also decreased significantly during six months storage period, which might be due to evaporation of moisture from the product. The least moisture content was recorded in 60 per cent glycerol followed by sucrose + glycerol and sucrose (Table 1). This might be due to lower molecular weight of glycerol than sucrose. Increasing the amount of glycerol increased the osmotic pressure gradient and thereby increased the water loss. Pattanapa *et al* (2010) also reported similar results in osmotically dehydrated mandarin.

3.3 Water activity (a_w) of Intermediate Moisture Aonla Segments During Storage

The water activity also decreased significantly during six months storage as shown in Table 1. It was found to be maximum in 60 per cent sucrose (0.783) and minimum in 60 per cent glycerol (0.735). This may be because of glycerol, a polyhydric alcohol, reduced the activity of water by hydrogen binding with it (Charley, 1982). The results are also in agreement with the findings of Ayub *et al* (2003), who reported an decrease in water activity of persimmon slices.

3.4 Total soluble solids of Intermediate Moisture Aonla Segments During Storage

The total soluble solids in intermediate aonla segments increased significantly during six months storage and ranged between 32.0 to 48.9 per cent. This might be due to conversion of polysaccharides into sugars during hydrolysis process. Increase in TSS might also be attributed to decrease in moisture content of the product with storage. It was found to be maximum in 60 per cent glycerol and minimum in 60 per cent sucrose (Table 1). This indicated that a decrease in molecular size of solute could enhance the solid gain. In fact, the mass transfer of solute is dependent on the effective diffusion coefficient that can be affected by the radius of molecules. Similar results were reported by Azoubel and Murr (2004).

3.5 Ascorbic acid of Intermediate Moisture Aonla Segments During Storage

The ascorbic acid in intermediate aonla segments decreased significantly during six months storage. Reduction in vitamin C could be due to oxidation by oxygen which resulted in formation of dehydroascorbic acid. The maximum retention of ascorbic acid was observed in 60 per cent glycerol (427 mg/100 g) followed by sucrose+ glycerol (399 mg/100 g) and sucrose (354 mg/100 g) (Table 4). The effect could be attributed to the concentration of vitamin C present in the cellular tissue as a consequence of dewatering (Pattanapa *et al*, 2010).

3.6 Overall acceptability of Intermediate Moisture Aonla Segments During Storage

The sensory evaluation of the product was done using a 9-point hedonic scale. The overall acceptability was observed in terms of color, appearance, taste, texture and mouthfeel. The 60 per cent glycerol treated intermediate moisture aonla segments were found to have the least score of 8.0, which decreased to 5.7 after six months storage (Table 1). Adding sucrose solution to glycerol solution, the osmotic agent improved the overall acceptability of intermediate moisture aonla segments.

Table 1: Changes in chemical parameters and overall accetability of IMF aonla segments cv. Banarasi during storage.

Moisture Content (%)								
Treatments	Storage period (months)							
	0	1	2	3	4	5	6	Mean
Sucrose	31.33	29.67	27.33	26.00	24.67	23.33	20.00	26.05
Sucrose +Glycerol (1:1)	27.33	27.33	26.00	24.67	23.00	21.33	19.67	24.19
Glycerol	24.67	24.33	23.33	22.67	22.00	20.00	19.00	22.29
Mean	27.78	27.11	25.55	24.45	23.22	21.55	19.56	
CD at 5%	Treatments (T) = 0.443 Storage (S) = 0.410, T×S = 1.084							

Water activity (aw)								
Sucrose	0.783	0.771	0.761	0.751	0.738	0.721	0.709	0.748
Sucrose +Glycerol (1:1)	0.768	0.749	0.735	0.729	0.720	0.708	0.691	0.729
Glycerol	0.735	0.719	0.710	0.704	0.693	0.670	0.654	0.698
Mean	0.762	0.746	0.735	0.728	0.717	0.700	0.685	
CD at 5%	Treatments (T) = 0.003 Storage (S) = 0.003, T×S = 0.007							
Total soluble solids (%)								
Sucrose	32.1	33.7	35.5	36.2	37.9	40.1	43.1	36.9
Sucrose +Glycerol (1:1)	35.5	37.1	38.8	40.0	42.2	43.9	45.1	40.4
Glycerol	37.9	38.5	41.5	42.5	44.2	46.1	48.9	42.8
Mean	35.2	36.4	38.6	39.6	41.4	43.4	45.7	
CD at 5%	Treatments (T) = 0.092 Storage (S) = 0.085, T×S = 0.226							
Ascorbic acid (mg/100g)								
Sucrose	354	313	284	246	203	170	133	243
Sucrose +Glycerol (1:1)	399	350	319	265	228	184	165	273
Glycerol	427	392	345	290	252	219	185	301
Mean	393	352	316	267	228	191	161	
CD at 5%	Treatments (T) = 3.721 Storage (S) = 3.445, T×S = 9.115							
Overall acceptability								
Sucrose	8.8	8.5	8.1	7.8	7.5	7.0	6.8	7.8
Sucrose +Glycerol (1:1)	8.7	8.5	8.0	7.6	7.0	6.4	6.2	7.5
Glycerol	8.0	7.7	7.4	7.0	6.6	6.0	5.7	6.9
Mean	8.5	8.2	7.8	7.5	7.0	6.5	6.2	
CD at 5%	Treatments (T) = 0.191 Storage (S) = 0.177, T×S = NS							

4. Conclusion

The intermediate moisture aonla segments were made by using three osmotic solutions i.e., sucrose, sucrose+glycerol (1:1) and glycerol) of 60 per cent strength. From the study, it was concluded that increasing the amount of glycerol in osmotic syrup significantly decreased the moisture content and water activity, and significantly increased the solid gain in intermediate moisture aonla segments. The retention of ascorbic acid in intermediate moisture aonla segments was also significantly affected by various treatments. The 60 per cent sucrose+glycerol treatment was found to retain

more ascorbic acid in the product and also developed more acceptable IMF aonla segments on sensorial basis. Intermediate moisture aonla segments in 60 per cent glycerol syrup treatment, although, retained maximum ascorbic acid but were not overall acceptable. The 60 per cent sucrose treated intermediate moisture aonla segments got the highest sensory score over other two treatments but retained the minimum ascorbic acid.

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