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Study on development of suitable ways for preparation and preservation of dehydrated pomegranate arils

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Abstract

Pomegranate fruits used in the experiment where cut and arils from them were carefully extracted. Then the arils were initially dipped in a chemical solution for five minutes with hot water blanching for five seconds and final dipping in another chemical solution for five minutes. Seven such treatment combinations including control were selected for the study. After that dehydration were carried out at a temperature range of 60-70 ^{0}C. The dehydrated arils were then pre packed and the sealed packets were kept inside desiccators at ambient condition. Observations for different parameters were recorded at initial day and at timely intervals during storage. The study showed that pomegranate arils which were initially dipped in citric acid 1% followed by hot water blanching for 5 seconds and final dipping with sodium metabisulphite 0.2% was the best pretreatment combination, as it was able to maintain considerable concentration of various parameters throughout the storage period.

Keywords: Pomegranate, arils, chemicals, dehydration, analysis

Introduction

The pomegranate plant yields a fruit which is round in shape having a thick peel which changes its colour to red at optimum stage of harvest (Morton, 1987) [17]. Pomegranate fruit possesses several health benefits. The juicy arils which are portion to be consumed contain several important components such as sugars, acids, minerals and carbohydrates (Kulkarni *et al*., 2004) [13]. Also the ability of the fruit to show its effect against the free radicals deposited in our body is also very good. It has been found that the juice obtained from the arils is highly rich in antioxidants which is three times higher than that of the antioxidant content of green tea (Gil *et al*., 2000) [8] and many times higher compared to the free radical neutralizing capability of cranberry, grape and grapefruit (Rosenblat *et al.*, 2006) [25]. Therefore presence of several beneficial ingredients makes it a very demandable fruit for consumption (Adams *et al*., 2006) [1].

However irrespective of the high nutritional profile the thick and strong outer layer which causes the extraction of the arils extremely difficult and low shelf life due to high moisture content restricts its utility to a greater extent. Considering these issues development of minimally processed pomegranate arils can be used as an important alternative. Dehydration technology can be successfully adopted to create dehydrated arils which can be stored for some time. However prior to dehydration, subjection of the fruit or fruit parts to some pretreatments becomes very necessary step which helps in improving the final status of the product. Previous studies have also shown that giving pretreatments before dehydration have been found useful in cherries, plums and grapes (Pangavhane *et al.*, 1999; Tulasidas *et al.*, 1996; Saravacos *et al.*, 1988; Ponting and McBean, 1970) [20, 31, 26, 23]. Therefore keeping in mind the highly nutritive but perishable nature of the fruit and also its difficulty in consumption, the present study was undertaken to develop dehydrated pomegranate arils which and can also preserved for a considerable period of time.

Materials and methods

The study was done in the laboratory of Department of Horticulture under the Institute of Agricultural Science, University of Calcutta during the winter season of 2017-18. The fruits after bringing in the laboratory were cut by hand using a knife and the arils were carefully removed.

Thereafter the arils were dipped in a chemical solution for 5 minutes which was followed by hot water blanching. Repeated trials were conducted to standardize the blanching time as because after when the blanching was completed the arils were losing its colour. Finally blanching time of 5 seconds was selected which retained the pigment content. After the hot water blanching the arils were immediately dipped in cold water containing another chemical treatment for 5 minutes. The way of dipping the arils in treatments were as per the works of Das and Dhua, (2019) [3]. The chemical for pretreatments utilized in the study are similar to that of the work of Veli *et al*., (2007); Kostaropoulos and Saravacos, (1995); Kingsly *et al*., (2007); Doymaz, (2004a,b); El-Beltagy *et al*., (2007); Pan *et al*., (2008); Marquez-Rios *et al*., (2009); Thakur *et al*., 2010; Das and Dhua 2019 [33, 12, 11, 5, 6, 7, 19, 15, 30, 3]. The different chemical combination in the experiment used as treatments before dehydration are as follows.

T_1 – Ascorbic acid 1% + 5 second hot water blanching + potassium metabisulphite 0.2%
T_2 – Citric acid 1% + 5 second hot water blanching + potassium metabisulphite 0.2%
T_3 – Calcium chloride 1% + 5 second hot water blanching + potassium metabisulphite 0.2%
T_4 – Ascorbic acid 1% + 5 second hot water blanching + sodium metabisulphite 0.2%
T_5 – Citric acid 1% + 5 second hot water blanching + sodium metabisulphite 0.2%
T_6 – Calcium chloride 1% + 5 second hot water blanching +sodium metabisulphite 0.2%
T_7 – Control

After treating the arils they were pre packed and sealed and stored in desiccators at ambient condition. All the treatments were replicated three times and the Completely Randomized Design was used for experimental design (Gomez and Gomez, 1984) [9]. Furthermore online software was used for statistical analysis (Sheoran *et al*., 1998) [28]. Observations were recorded for physical attributes like moisture content on dry weight basis (Shipley and Vu, 2002) [29], appearance quality (Peryam and Girardot, 1952; Peryam and Pilgrim, 1957) [21,22] and chemical parameters viz. total sugars (Rangana, 2003) [24], reducing sugars (Rangana, 2003) [24], anthocyanin content (Rangana, 2003) [24] and radical scavenging activity (Brand-Williams *et al*., 1995) [2] on initial day and at 15, 30 and 45 days of storage.

Results and Discussion

All the pretreated pomegranate arils showed periodic loss of moisture content (dry weight basis) with gradual passage of dehydration time (Figure 1). At earlier minutes of dehydration the loss of moisture content (dry weight basis) from all the pretreated pomegranate arils was very fast, which gets stabilized later with further passage of dehydration time.

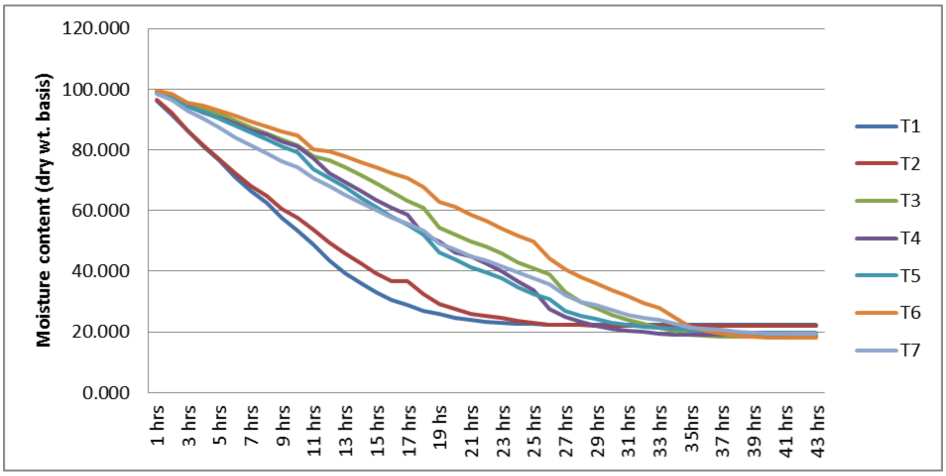

Fig 1: Moisture Content (dry weight basis) of the pretreated dehydrated pomegranate arils at different days of storage

Table 1 show the appearance score (in a 9 point scale with decreasing order of preference) of the dehydrated arils for all the treatments which at the initial day of storage were at their maximum of 9. Thereafter the score decreased for all the treatments considerably throughout the storage period. At the end of the experiment through the appearance score of all the treatments were reduced, but still appreciable values were depicted by pomegranate arils pretreated with combination of citric acid 1% followed by hot water blanching for 5 seconds and final dipping in sodium metabisulphite 0.2% (T_5) which was followed by pomegranate arils where initial dipping with citric acid 1% then hot water blanching (5 seconds) and final dipping with potassium metabisulphite 0.2% (T_2) was done.

Table 1: Appearance quality of the pretreated dehydrated pomegranate arils at different days of storage

Treat/Time	0 DAS	15 DAS	30 DAS	45 DAS
T_1	9.00	8.00	6.67	3.33
T_2		8.33	7.33	6.00
T_3		8.00	7.00	4.33
T_4		8.00	6.33	4.33
T_5		8.67	7.67	6.33
T_6		8.33	7.00	5.33
T_7		7.33	5.33	2.33
CD at 5%	-	NA	0.863	0.945
S.Em±	-	0.252	0.282	0.309

The concentration for the percentage of total sugar (Table 2) continuously declined throughout the storage period. At the first interval of storage at 15 days the total sugars decreased but at minute fraction and no considerable difference were seen among the treatments. Treatments T_2 (Citric acid 1% + blanching + potassium metabisulphite 0.2%), T_4 (Ascorbic acid 1% + blanching + sodium metabisulphite 0.2%), T_5 (Citric acid 1% + blanching + sodium metabisulphite 0.2), T_6 (Calcium chloride 1% + blanching + sodium metabisulphite 0.2%) recorded a similar values of 14.67% of total sugars and T_7 (Control) with the least concentration of 14.10%. But at 30 and 45 days storage the decline was a bit more as compared to the values of total sugars at 15 days of storage. At the end of the storage study it was seen that the dehydrated pomegranate arils of T_5 (Citric acid 1% + blanching + sodium metabisulphite 0.2%) was able to withhold the maximum percentage of total sugars 13.91% and dehydrated pomegranate arils with T_7 were with the value of 12.03%.

Table 2: Total sugar (%) of the pretreated dehydrated pomegranate arils at different days of storage

Treat/Time	0 DAS	15 DAS	30 DAS	45 DAS
T_1	14.73	14.33	13.28	12.48
T_2		14.67	14.04	13.82
T_3		14.65	13.76	13.29
T_4		14.47	13.69	12.79
T_5		14.67	14.27	13.91
T_6		14.67	13.96	13.64
T_7		14.10	12.90	12.03
CD at 5%	-	0.032	0.041	0.060
S.Em±	-	0.011	0.014	0.020

The reducing sugar content (Table 3) at the initial day of storage recorded the maximum of 13.07% which was similar for all the treatments. At 15 days of storage maximum values for the concentration of reducing sugars percentage was seen for dehydrated pomegranate arils treated with T_5 (Citric acid 1% + blanching + sodium metabisulphite 0.2%) showing 13.01%, which was followed by dehydrated pomegranate arils treated with T_2(Citric acid 1% + blanching + potassium metabisulphite 0.2%). A similar declination pattern for the percentage of reducing sugars was seen among the different pretreated dehydrated pomegranate arils. Thus at 45 days of storage T_5 (Citric acid 1% + blanching + sodium metabisulphite 0.2%) recorded the maximum value of 12.11% which was followed by the second best treatment of T_2 (Citric acid 1% + blanching + potassium metabisulphite 0.2%) showing 11.91% of reducing sugars. Control arils documented the least value of 10.58%.

Table 3: Reducing sugars (%) of the pretreated dehydrated pomegranate arils at different days of storage

Treat/Time	0 DAS	15 DAS	30 DAS	45 DAS
T_1	13.07	12.46	11.70	10.97
T_2		12.96	12.76	11.91
T_3		12.86	12.14	11.33
T_4		12.54	11.84	11.17
T_5		13.01	12.76	12.11
T_6		12.96	12.35	11.82
T_7		12.22	11.40	10.58
CD at 5%	-	0.030	0.044	0.065
S.Em±	-	0.010	0.014	0.021

The 0 day or the initial day of storage of different pretreated pomegranate arils showed the value of 36.81 mg/100 gm of anthocyanin concentration (Table 4). The pigment concentration at this very first day of storage were found to be at their utmost but diminished thereafter. The reduction of the anthocyanim pigment concentration was not very high at 15 days of storage. But analysis at 30 and 45 days of storage showed significant down fall in the pigment concentration. Among the treatments T_5 (Citric acid 1% + blanching + sodium metabisulphite 0.2%) was found to be the most acceptable which helped in retaining the maximum concentration of the pigment and untreated control showed the highest loss.

Table 4: Anthocyanin content (mg/100g) of the pretreated dehydrated pomegranate arils at different days of storage

Treat/Time	0 DAS	15 DAS	30 DAS	45 DAS
T_1	36.81	28.81	24.10	17.38
T_2		32.75	29.94	21.71
T_3		31.55	27.55	18.93
T_4		25.15	24.81	18.93
T_5		34.84	30.71	25.48
T_6		32.62	29.28	20.60
T_7		26.58	20.09	12.97
CD at 5%	-	NA	0.242	0.078
S.Em±	-	2.264	0.079	0.025

Table 5 contains the values of antioxidant activity expressed as percent inhibition of DPPH for different pretreated dehydrated pomegranate arils calculated at periodic intervals during the storage study. During the storage when analysis was carried at 15, 30 and 45 days the antioxidant activity amongst the various pretreated dehydrated pomegranate arils as like other attributes decreased. At the end of the experiment highest antioxidant activity (percent inhibition of DPPH) was seen for T_5 (Citric acid 1% + blanching + sodium metabisulphite 0.2%) of 52.09 followed by with T_2 (Citric acid 1% + blanching + potassium metabisulphite 0.2%), T_6 (Calcium chloride 1% + blanching + sodium metabisulphite 0.2%), T_3 (Ccalcium chloride 1% + blanching + potassium metabilsulphite 0.2%), T_4 (Ascorbic acid 1% + blanching + sodium metabisulphite 0.2%), T_1 (Ascorbic acid 1% + blanching + potassium metabisulphite 0.2%) and T_7 (Control) recorded the least value of 19.24.

Table 5: Antioxidant activity (percent inhibition of DPHH) of the pretreated dehydrated pomegranate arils at different days of storage

Treat/Time	0 DAS	15 DAS	30 DAS	45 DAS
T_1	66.87	53.52	40.08	27.44
T_2		62.65	55.68	44.40
T_3		56.92	47.59	35.57
T_4		56.06	42.91	31.58
T_5		64.49	60.66	52.09
T_6		59.56	51.60	39.69
T_7		49.63	33.02	19.24
CD at 5%	-	0.433	0.334	0.441
S.Em±	-	0.141	0.109	0.144

In the experiment pretreatments helped in increasing the post harvest life of the dehydrated pomegranate arils. The pigment concentration is maintained by inactivation of the enzymes. Furthermore the time required for dehydration also got reduced as the firmness of the tissues became lowered (Kingsly *et al*., 2007) [11]. In the present investigation hot water blanching is also adopted which becomes very important for loosening the inner cells which helps in dehydration and also imparts proper shrinkage of the commodity (Kunzek *et al*., 1999; Munyaka *et al*., 2010; Waldron *et al*., 2003) [14, 18, 34]. Finally dehydration helps in reducing the bulk volume by lowering the internal water content and reduces the chances of microbial contamination and spoilage (Hatamipour *et al*., 2007) [10]. Also dehydration diminishes the activity of enzymes like peroxidase and lipoxygenase which in turn helps in preventing the browning and maintaining of aroma of the final produce (Vamos-Vigyzao, 1995; McEvily *et al*., 1992) [32, 16]. The total sugar content decreased during the period of the study. The observations were at par to the previous reports of Sharma *et al*., (2013) [27] on anardana. The result regarding the antioxidant content showed a decreasing pattern and it was similar to the work of Das *et al*., (2019) [4] on pomegranate leather.

Conclusion

From the study it was found that the various physical and chemical properties viz. appearance quality, reducing sugars, total sugars, non reducing sugars, anthocyanin content, antioxidant capacity were at their very maximum for all the pretreated dehydrated pomegranate arils at the initial day of storage. However all the physical and chemical attributes declined throughout the storage period when analysis was carried out at 0, 15, 30 and 45 days of storage interval. Though parameters for all the treatments by which pomegranate arils were pretreated prior to dehydration reduced, but it was seen that pomegranate arils where citric acid 1% followed by blanching for 5 seconds and steeping with sodium metabisulphite 0.2% (T_5) used as pretreatment was able to maintain significant higher values for all the attributes. Control dehydrated arils throughout the storage study was found to be suffering from maximum loss.

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