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RESEARCH ARTICLE

Standardization of methods for preparation of pomegranate jam

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ABSTRACT

Fresh and fully matured pomegranate fruits were taken for the study of standardizing methods for preparation of jam with specified concentration of pectin of 15, 18 and 20% and sodium benzoate of 100 and 150 ppm respectively. Two heating techniques that is induction heating (I.H.) and microwave heating (M.H.) were used to prepare the jam. Thereafter different parameters such as total sugar, reducing sugar, total phenolic content, appearance score, and fungal count were analyzed at different day's interval. The jam prepared were kept in sterilized glass jars and stored in refrigerated condition. All the treatments were replicated three times and two factorial Completely Randomized Design was used for statistical analysis. From the study it was observed that pomegranate prepared with 20 % pectin and 150 ppm sodium benzoate and jam with 15% pectin and 100 ppm of sodium benzoate were good and the microwave heating (M.H.) gave better results over induction heating (I.H.).

Keywords: Pomegranate, treatments, heating, jam, postharvest

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INTRODUCTION

Pomegranate is a well known nutritious fruit. Pomegranate's popularity is growing among producers and consumers worldwide because to its cheap maintenance cost, tolerance to biotic and abiotic stresses, high producing potential, improved keeping quality, and increased nutraceutical fruit value (Dhinesh and Ramasamy, 2016). It is reach in polyphenols, ellagic acid, punicalgins, tannins and anthocyanin which attribute in the red color of skin and arils of the fruit. The pomegranate rind, stem bark, and root contain more than 28% gallotannic acid and colour, which is used in tanning as a natural bio-dye. Punicalgins are antioxidants found solely in the pomegranate's outer peel and are considered to have twice the antioxidant capacity of red wine and green tea (Sevda and Rodrigues, 2011). It is rich in antioxidant which counterbalances the free radical in our body which helps us in boosting our immune system. The alkaloid also helps in lowering tension, anxiety and imparts anti carcinogenic properties. It also helps in glowing skin and reducing hair fall.

Processing in case of pomegranate is one of the most important post harvest method due to the changing lifestyle of people as it can be easily consumed with high functional property. The extraction of juicy arils is difficult and troublesome due to the hard rind of the fruit. Hence, different value added products like jam, juice, jelly etc are available in the market for direct consumption

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and ready to serve purpose. Jam is a classic food that may be eaten with almost anything. Pomegranate is available all year in India that could aid in the development of a various value-added products with high market return. Fruits are generally perishable by nature, different additives such as acid, sugar, pectin, and thermal processing are used in the production of jam to decrease post-harvest losses and give a better product to consumers. For this study two heating methods were incorporated that is induction heating (I.H.) and microwave heating (M.H.). Induction heating employs electromagnetic energy that offers a number of benefits, including high safety, scalability, and energy productivity. This technology's applicability in the food processing sector is still in its early phases (Hamed et al., 2016). Microwave heating on the other hand offers a faster rate of heating and does not require direct contact between the heating source and the heated item. Microwave heated items to a certain temperature, will result in a higher-quality product with fewer nutritional changes (Mohd Ismail et al., 2018). Thus, the present study was undertaken where raw pomegranate fruits were taken and converted to jam by utilization of two heating methods. The study was aimed to analyze various properties of jam, different heating techniques, to increase the shelf life and the utility of the product.

MATERIALS AND METHODS

The research work was conducted in the laboratory of Department of Horticulture, Institute of Agricultural Sciences, University of Calcutta, in the academic year of 2019-2020. Fresh and fully matured pomegranate fruits were procured from the commercial enterprise. The arils were extracted macerated in a juicer for extraction of juice. Then the juice was heated for the preparation of jam by using two mode of heating that is induction heating (I.H.) and microwave heating (M.H.). Specified concentration of pectin and sodium benzoate was added with continuous stirring while heating. The treatments which were used in the study were **T_1** - Pomegranate juice + 15% pectin + 100 ppm of Sodium benzoate, **T_2**- Pomegranate juice + 15% pectin + 150 ppm of Sodium benzoate, **T_3**- Pomegranate juice + 18% pectin + 100 ppm of Sodium benzoate, **T_4**– Pomegranate juice + 18% pectin + 150 ppm of Sodium benzoate, **T_5**- Pomegranate juice + 20% pectin + 100 ppm of Sodium benzoate and **T_6**- Pomegranate juice + 20% pectin + 150 ppm of Sodium benzoate. Three replications were made for every treatment and two factorial Completely Randomized Design (Gomez and Gomez, 1984; Sheoran et al., 1984) was used as the statistical design.

The jams prepared were kept in sterilized glass jars and stored in refrigerated condition. Observations were done in the laboratory at varied intervals of storage. Parameters used for the study were total sugar (Rangana, 2003), reducing sugar (Rangana, 2003), total phenolic content (Singleton et al., 1999), appearance quality (Peryam and Girardot, 1952; Peryam and Pilgrim, 1957) and total fungal count (Allen, 1953).

RESULTS AND DISCUSSION

Total sugar

The following results as displayed in Table 1 were seen in case of total sugar as for the treatments prepared by microwave heating (M.H.) a gradual increase was there. At 30 days of storage it was observed that the least accumulation was found in T2 (Pomegranate juice + 15% pectin + 150 ppm of Sodium benzoate) followed by T1 (Pomegranate juice + 15% pectin + 100 ppm of Sodium benzoate) and T4 (Pomegranate juice + 18% pectin + 150 ppm of Sodium benzoate). A similar kind of observations was recorded for the treatments prepared by induction heating (I.H.). However the rise here was a bit more as compared to the treatments of microwave heating (M.H.). Here also the least accumulation at the end of storage was seen by T2 (Pomegranate juice + 15% pectin + 150 ppm of Sodium benzoate), depicting a value of 48.29% which was followed by T1 (Pomegranate juice + 15% pectin + 100 ppm of Sodium benzoate) showing an amount of 49.63%. The deposition was seen in T5 (Pomegranate juice + 20% pectin + 100 ppm of Sodium benzoate) with a value of 60.65%.

Table 1: Total Sugar (%) of the prepared pomegranate jam at different days of storage.

0 DAS	M.H.	I.H.	Mean A	30 DAS	M.H.	I.H.	Mean A
T1	35.24	39.87	37.56	**T1**	40.21	49.63	44.92
T2	35.24	39.43	37.33	**T2**	38.24	48.29	43.27
T3	40.39	43.33	41.86	**T3**	45.17	58.66	51.92
T4	38.47	42.21	40.34	**T4**	40.32	53.72	47.02
T5	40.99	47.21	44.10	**T5**	48.08	60.65	54.36
T6	40.56	47.84	43.20	**T6**	47.28	58.66	52.97
Mean B	38.48	43.31		**Mean B**	43.22	54.94	
Factors	**C.D.**	**SE(d)**	**SE(m)**	**Factors**	**C.D.**	**SE(d)**	**SE(m)**
Factor(A)	0.148	0.071	0.05	**Factor(A)**	0.155	0.074	0.053
Factor(B)	0.085	0.041	0.029	**Factor(B)**	0.089	0.043	0.03
Factor(A X B)	0.209	0.101	0.071	**Factor(A X B)**	0.219	0.105	0.074

Table 2: Reducing sugar (%) of the prepared pomegranate jam at different days of storage.

0 DAS	M.H.	I.H.	Mean A	30 DAS	M.H.	I.H.	Mean A
T1	25.32	30.40	27.86	**T1**	31.45	41.50	36.48
T2	26.60	27.62	27.11	**T2**	30.52	41.50	36.01
T3	29.11	38.46	33.79	**T3**	34.95	48.42	41.68
T4	29.11	34.51	31.81	**T4**	32.34	44.49	38.42
T5	31.51	40.05	35.78	**T5**	39.28	52.50	45.89
T6	33.46	40.05	36.75	**T6**	38.24	49.66	43.95
Mean B	29.19	35.18		**Mean B**	34.46	46.35	
Factors	**C.D.**	**SE(d)**	**SE(m)**	**Factors**	**C.D.**	**SE(d)**	**SE(m)**
Factor(A)	0.226	0.109	0.077	**Factor(A)**	0.827	0.398	0.282
Factor(B)	0.13	0.063	0.044	**Factor(B)**	0.477	0.23	0.163
Factor(A X B)	0.32	0.154	0.109	**Factor(A X B)**	1.169	0.563	0.398

Reducing sugar

Table 2 shows as like of total sugar, the amount of reducing sugar also increased during the storage. For treatments prepared with microwave heating (M.H.) there was a gradual elevation in the reducing sugar amount and least deposition was seen for T2 (Pomegranate juice + 15% pectin + 150 ppm of Sodium benzoate) with 30.52% and highest by T6 (Pomegranate juice + 20%

pectin + 150 ppm of Sodium benzoate) and T5 (Pomegranate juice + 20% pectin + 100 ppm of Sodium benzoate) with 38.24% and 39.28 % respectively. Likewise for the treatments under induction heating (I.H.) the increase was a bit sharp and though similar trend was observed in T2 (Pomegranate juice + 15% pectin + 150 ppm of Sodium benzoate) and T1 (Pomegranate juice + 15% pectin + 100 ppm of Sodium benzoate) were with the lowest amounts.

Total phenolic content

The phenolic content is depicted in Table 3 for the treatments prepared by microwave heating (M.H.) the maximum maintenance of phenols at 30 days of storage was seen by T6 (Pomegranate juice + 20% pectin + 150 ppm of Sodium benzoate) followed by T5 (Pomegranate juice + 20% pectin + 100 ppm of Sodium benzoate) and T4 (Pomegranate juice + 18% pectin + 150 ppm of Sodium benzoate). The rate of declination was much more pronounced in the treatments prepared by induction heating (I.H.) as compared to the former one. Lastly it was observed that at 30 days of storage the highest with holding of the phenols in case of induction heating (I.H.) was seen for T4 (Pomegranate juice + 18% pectin + 150 ppm of Sodium benzoate) followed by T5 (Pomegranate juice + 20% pectin + 100 ppm of Sodium benzoate) and T1 (Pomegranate juice + 15% pectin + 100 ppm of Sodium benzoate) depicted with the least concentration.

Table 3: Total phenolic content (mgGAE/g) of the prepared pomegranate jam at different days of storage.

0 DAS	M.H.	I.H.	Mean A	30 DAS	M.H.	I.H.	Mean A
T1	19.33	10.56	14.94	**T1**	16.08	5.98	
T2	21.33	10.56	15.95	**T2**	16.50	6.88	11.69
T3	22.64	11.01	16.82	**T3**	16.50	7.14	11.82
T4	23.42	13.19	18.30	**T4**	17.82	9.62	13.72
T5	25.44	18.35	21.90	**T5**	17.82	8.05	12.93
T6	30.23	20.47	25.35	**T6**	18.33	7.58	12.96
Mean B	23.73	14.02	18.88	**Mean B**	17.17	7.54	
Factors	**C.D.**	**SE(d)**	**SE(m)**	**Factors**	**C.D.**	**SE(d)**	**SE(m)**
Factor(A)	1.549	0.746	0.527	**Factor(A)**	1.31	0.631	0.446
Factor(B)	0.894	0.431	0.305	**Factor(B)**	0.756	0.364	0.258
Factor(A X B)	N/A	1.055	0.746	**Factor(A X B)**	N/A	0.892	0.631

Appearance score

Appearance score of the jam is shown in Table 4. A 9 point hedonic scale was used to judge the score . For treatments by microwave heating (M.H.) at 30 days of storage the highest score of 8.0 was seen for T6 (Pomegranate juice + 20% pectin + 150 ppm of Sodium benzoate) followed by 7.67 in T5 (Pomegranate juice + 20% pectin + 100 ppm of Sodium benzoate). Likewise in case of treatments by induction heating (I.H.) at the end of storage a similar kind of observation was observed and quiet an appreciable score was seen for the treatments T4 (Pomegranate juice + 18% pectin + 150 ppm of Sodium benzoate), T5 (Pomegranate juice + 20% pectin + 100 ppm of Sodium benzoate), and T6 (Pomegranate juice + 20% pectin + 150 ppm of Sodium benzoate).

Table 4: Appearance Score of the prepared pomegranate jam at different days of storage

0 DAS	15 DAS	M.H.	I.H.	Mean A	30 DAS	M.H.	I.H.	Mean A
	T1	7.67	7.33	7.50	**T1**	6.67	5.33	6.00
	T2	7.67	7.67	7.67	**T2**	7.00	6.00	6.50
	T3	8.00	8.00	8.00	**T3**	7.33	6.00	6.67
	T4	8.67	8.67	8.67	**T4**	7.33	6.67	7.00
	T5	8.67	8.33	8.50	**T5**	7.67	6.67	7.17
	T6	9.00	9.00	9.00	**T6**	8.00	7.00	7.50
A(1-6) B1 9.00	**Mean B**	8.28	8.17		**Mean B**	7.33	6.28	
	Factors	**C.D.**	**SE (d)**	**SE (m)**	**Factors**	**C.D.**	**SE (d)**	**SE (m)**
	Factor (A)	0.565	0.272	0.192	**Factor(A)**	0.529	0.255	0.18
	Factor (B)	N/A	0.157	0.111	**Factor(B)**	0.305	0.147	0.104
	Factor (A x B)	N/A	0.385	0.272	**Factor (A x B)**	N/A	0.36	0.255

Fungal count

Fig. 1 and Fig 2 show the fungal population of the pomegranate jams prepared with different concentration of pectin and heating methods. Initially there was no as such fungal colony development in the 15 days apart from T3 (Pomegranate juice + 18% pectin + 100 ppm of Sodium benzoate) in case of microwave heating (M.H.) and T2 (Pomegranate juice + 15% pectin + 150 ppm of Sodium benzoate) in case of induction heating (I.H.) showed one fungal colonies each. However at 30 days there was an increase in the fungal load. For treatments under microwave heating (M.H.) T5 (Pomegranate juice + 20% pectin + 100 ppm of Sodium benzoate) reported with 4.33 colonies which was followed by 4.67colonies for T4 (Pomegranate juice + 18% pectin + 150 ppm of Sodium benzoate), and T1 (Pomegranate juice + 15% pectin + 100 ppm of Sodium benzoate) reported with 7.33 colonies. However for treatments under induction heating (I.H.) at 30 days the fungal contamination was much more. T4 (Pomegranate juice + 18% pectin + 150 ppm of Sodium benzoate) reported with 5.33 colonies, T6 (Pomegranate juice + 20% pectin + 150 ppm of Sodium benzoate) with 8 colonies and T5 (Pomegranate juice + 20% pectin + 100 ppm of Sodium benzoate) documented 9 colonies. The other treatments showed more than 10 colonies with highest of 11.67 colonies for T1 (Pomegranate juice + 15% pectin + 100 ppm of Sodium benzoate).

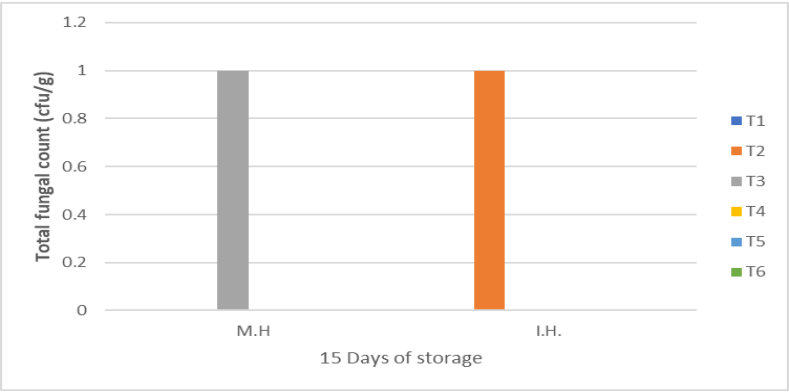

Fig. 1: Total fungal count (x 10^2cfu/g) of the prepared pomegranate jam at 15 days of storage

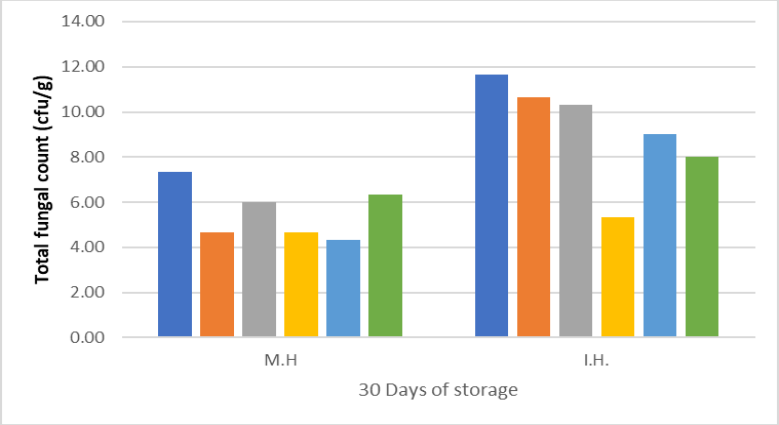

Fig. 2: Total fungal count of the prepared pomegranate jam at 30 days of storage

The present study of pomegranate jam which was prepared by addition of different concentration of pectin and utilization of heating techniques viz. microwave heating and induction heating , different parameters were taken into consideration. In the study it was obtained that the concentration of total sugar and reducing sugar increased during the period of study. A similar kind of result where these parameters got increased was obtained by Sutwal et al., (2019) in their study where jam from apple having low calorie value was prepared. Also the results showed that the phenolic concentration of the pomegranate jam declined during the period study and the finding was at par the earlier report of Pilizota et al., (2009) where they analyze various parameters of strawberry jams. Furthermore the present study shows that the maintenance of the attributes were better for the treatments prepared by microwave heating (M.H) as compared to induction heating (I.H.) . This result is also in accordance with the earlier work of Souilem et al., (2015) where they study the effectiveness of the use of microwave energy to produce orange jam as compared to the conventional heating methods.

CONCLUSION

From the study it was obtained that with respect to total sugar concentration the treatment T2 (Pomegranate juice + 15% pectin + 150 ppm of Sodium benzoate) showed the least accumulation at the end of the storage for both microwave heating (M.H.) and induction heating (I.H.). A similar result of increasing pattern with less deposition for T2 (Pomegranate juice + 15% pectin + 150 ppm of Sodium benzoate) was seen for reducing sugar. The phenols concentration decreased during the study and the decline was more in induction heating (I.H.) prepared treatments. For microwave heating (M.H.) T6 (Pomegranate juice + 20% pectin + 150 ppm of Sodium benzoate) showed the maximum and for I.H. T4 (Pomegranate juice + 18% pectin + 150 ppm of Sodium benzoate) was with highest phenolic content. The appearance score reduced and the treatments like T6 (Pomegranate juice + 20% pectin + 150 ppm of Sodium benzoate) and T5 (Pomegranate juice + 20% pectin + 100 ppm of Sodium benzoate) showed good values for microwave heating (M.H.) and induction heating (I.H.) at the end. The fungal population increased at 30 days where treatments under microwave heating (M.H.) showed a range of 5-6 colonies, and for induction heating (I.H.) the no. of colonies were higher. Thus, we can conclude that over all treatments like T6 (Pomegranate juice + 20% pectin + 150 ppm of Sodium benzoate) and T1 (Pomegranate juice + 15% pectin + 100 ppm of Sodium benzoate) are suitable combination for the preparation of the pomegranate jam and with respect to heating the microwave heating (M.H.) was found superior over induction heating (I.H.).

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