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Quality and storage behaviour of amchur (Raw mango powder) as influenced by varietal differences of mango grown in Malda district

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Abstract

In the present investigation to determine the suitability of mango varieties for amchur (raw mango powder) preparation, five Malda grown mango varieties namely, Mohanbhog, Phunia, Fazli, Bharathi and Ashwina were utilized along with assessment of storage behavior of the end product. During the period of study moisture content, titratable acidity (%), reducing sugars, total sugars, ascorbic acid content, microbial count in the processed product and organoleptic evaluation were conducted from the initial day to 180th day of storage. With the advancement in the length of storage moisture and reducing sugar content and titratable acidity percentage showed a gradual increase upto 180 days of storage. The overall assessment of quality revealed that with respect to conjugal study of all these parameters amchur (raw mango powder) prepared from the variety Mohanbhog proved considerably superior. The maximum overall acceptability score (8.06) also had been gathered by amchur (raw mango powder) manufactured from Mohanbhog variety.

Keywords: Amchur, Malda, mango, overall acceptability, storage

Introduction

Mango (*Mangifera indica* L. Anacardiaceae) is the most widely cultivated fruit crop of India and reportedly there are over 1,000 varieties found in the country (Singh *et al.*, 2012) [13]. Its popularity and importance can easily be realized by the fact that it is referred to as the 'king of fruits' in the tropical world. Many of the commercial mango varieties emerged as chance seedlings during Mughal rules (Mukherjee *et al.*, 1968) [8]. India produces about 56% of the total mango in the world. Murshidabad and Malda districts of West Bengal state of India are famous for their mango varieties. More than 200 mango varieties were recorded during the time of the royals of the districts (Mukharjee, 1953) [7]. Post-harvest losses of fruits and vegetables in our country are very high i.e. 20 to 30% every year (Saigal, 2001) [12]. However only 2% of the total production is used for processing, where as this figure is more than 50% in developed countries (Roy, 2001) [11]. These losses can be minimized by in mango through utilizing green fruits for making pickle or chutney or as a sundried acidifying condiment (AMCHUR), where as ripe fruit is used for preserve, jam, squash etc. (Srivastava, 1998) [14]. The physico-chemical characteristics of mango fruits and the technological qualities of their processed products vary with mango varieties as some are more suitable than others for specific applications (Mercadante and Rodriguez, 1998) [6]. Raw mango yields a hard pulpy matter known for its acidic taste, and hence is used in different traditional food recipes, like pickles, chutneys and dry powder (Amchur). Sourness, pungency and salt are important aspects of Amchur that have major impact on the sensory scores. Reports are available regarding the dehydration of raw mangoes for preparation of amchur powder [raw mango powder RMP] (Dabhade and Khedkar, 1980) [2]. There has been a very little research work had been conducted to study the influences of mango cultivars on quality attributes and storage behavior of Amchur (Mango powder). Keeping this view, as the prime consideration, the present experiment had been chalked out to assess the varietal suitability of Malda grown mango cultivars for Amchur (Mango powder) preparation along with the storability study of the end product.

Materials and Methods

In the present research work half to ¾th mature mangoes were collected from ten blocks of Malda Sadar and Chanchal sub-division of Malda district, West Bengal, India (situated at 25 M above mean sea level; the latitude and longitude being 24°40'20"N to 25°32'08"N and 87°45'50"E to 88°28'10"E, respectively and Amchur was prepared at the Department of Post-Harvest Technology of Horticultural Crops, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia during the period from 2016-17 and 2017-18. The collection centre of mango fruits is situated in the Lower Gangetic Plain Agro Climatic Zone of West Bengal. The soil of the location was clay to loam and it was sufficiently deep. The pH of the soil was slightly acidic to neutral and varied from 6.0 to 6.8.

Preparation of Amchur

Total Number of varieties (Treatments): 5 (Mohanbhog, Ashwina, Fazli, Bharathi and Phunia)

Stage of fruit: Half to ¾th maturity stage

Storage condition: Ambient temperature

Packaging: Aluminum foil (200 gauge)

Methodology

The unripe mango fruits were collected, peeled and then cut into thin slices, immersed in 0.05% KMS solution and dried. The dried slices are grounded to powder and packed in Aluminum foil (200 gauge) and stored at room temperature.

Collection of mango fruits

The mango fruits of Fazli, Ashwina, Phunia, Bharathi and Mohanbhog varieties were collected from the mango orchard, Mango Research Station, Malda, West Bengal, India. Fruits are unripe and free from insect damages and diseases were selected for making the nutritious amchur.

Fruit maturity Stage of amchur

The green mango fruits were taken at the time of attainment of full size i.e. when skin colour is dark green or olive green. The fruits were medium to large in size and fruits were sour in taste.

Preparation of fruit slices

Fruits were weighed by using electronic balance, washed thoroughly with running tap water. The washed fruits were peeled with stainless steel knife. Edible portion of whole fruit was cut in to thin slices. Prepared slices were again weighed to record the yield recovery of fresh slices for preparation of amchur.

Tray drying

After taking samples, known weight of fruit slices of mango were spread thinly on aluminum trays which were kept in a tray drier for dehydration. Mango slices were thoroughly dried at 50-60 °C temperature till they reached the desired product quality.

Powdering of dehydrated mango

After complete drying, the dehydrated mango samples were subjected for grinding in the food processor to make powder of dried mango powder.

Dry weight of powder (g)

Total 5 kg raw mango fruits were selected. After washing,

peeling, slicing, drying they were grinded for the final powder preparation and weight of powder was expressed in grams.

Packaging and storage

After dehydration, the dried mango samples were weighed, packed in Aluminum foil (200 gauge, sealed and subjected for storage studies at room temperature (20-30 °C, 53-76% RH) or ambient conditions for a period of 6 months.

Observations recorded

During the period of study, observation on Moisture content (%), Ascorbic acid (mg 100 g⁻¹), Titratable acidity (%), Total sugars (%), Reducing sugars (%), Non reducing sugars (%), Microbial count in processed product and Organoleptic evaluation were assessed at initial day of storage, 30th, 60th, 90th, 120th, 150th and 180th day of storage. The details procedure of assessment was mentioned under physico-chemical analysis.

Statistical Analysis

For analysing the influence of variety and storage duration on the quality of mango (*Mangifera indica* L.) Amchur products of Malda district, the experiment was laid out in two factors Completely Randomized Design (CRD) with three replications. The varietal effects were taken as the first factor and the influence of storage intervals were considered as the second factor during the statistical analysis. The data relating to quality attributes of the processed mango products recorded during the period of experimentation were statistically analyzed by following analysis of variation method using MSTAT software. For inference 5% level of significance of 'F' and 't' test were applied.

Results and Discussion

The influence on quality of amchur prepared from different varieties of mango in conjunction with variable storage intervals had been studied upon judgement of certain parameters such as moisture content, titratable acid, reducing and total sugar and ascorbic acid content, overall acceptability score and incidence of infection of microorganism.

Influence on moisture content

Amchur prepared from different mango varieties i.e. Mohanbhog, Ashwina, Fazli, Bharathi and Phunia revealed remarkable differences under the sole influence of varieties with respect to moisture content (Table 1). The lowest moisture content (5.27%) was recorded in amchur prepared from the variety Bharathi, which was immediately followed by variety Mohan bhog (5.47%). Storage intervals showed prominent variation over this parameter. The value of moisture content increased from 4.62% to 6.46% from initial stage to 180 DAS. The difference between these two values showed statistical variation. The continuous increase in moisture content of amchur during storage, irrespective of varieties, might be due to continuous absorption of atmospheric water as a result of surface tension. The highest value (6.70%) for this parameter was recorded during at 180 DAS, in case of amchur prepared from both the varieties Fazli and Ashwina, whereas the lowest was seen as 4.40 at 0 DAS, where the amchur was made from the variety Bharathi. Similar moisture content (5.80±0.07%) at initial stage of amchur preparation also had been reported by Rao *et al.* (2008) [10].

Table 1: Moisture (%) content of amchur as influenced under the sole and interaction effects of variety of mango (*Mangifera indica* L.) and storage duration

Cultivars (V)	Storage interval days (D)							Mean
	0	30	60	90	120	150	180	
Mohanbhog	4.50	4.70	5.10	5.70	5.90	6.10	6.30	5.47
Phunia	4.70	4.90	5.30	5.70	6.00	6.20	6.50	5.61
Fazli	4.70	4.80	5.40	5.80	6.30	6.40	6.70	5.73
Bharathi	4.40	4.70	4.90	5.40	5.60	5.80	6.10	5.27
Ashwina	4.80	5.00	5.30	6.00	6.40	6.50	6.70	5.81
Mean	4.62	4.82	5.20	5.72	6.04	6.20	6.46	

Particulars	Variety (V)	Storage duration (D)	Variety X Storage duration (V X D)
S.Em. (±)	0.012	0.015	0.033
C.D. at 5% level	0.035	0.042	0.093

Influence on titratable acid content

The highest acidity percentage (8.65%) was registered from amchur produced from the variety Phunia, whereas the lowest acidity level (8.39%) was measured for amchur made from Bharathi (Table 2). Under the sole influence of varieties the acidity level of amchur produced considerable variation. The variation in acidity level of amchur prepared from different varieties might be due to their genotypic variation and as well as maturity stage and agro-climatic impact. Storage durations viz., 0, 30, 60, 90, 120, 150 and 180 DAS showed the acidity levels of amchur as 8.35%, 8.39%, 8.43%, 8.48%, 8.53%, 8.55% and 8.57%, respectively. However, the acidity levels obtained between any two successive storage duration were statistically *at par*, except between 60 and 90 DAS and 90 and 120 DAS. Similar results regarding the nature of ascending change of acidity level of amchur during storage also had been reported by Dabhade and Khedkar (1980) [2] and Bhardwal and Lal (1990) [1], while studying power prepared from mango and apple, respectively. As far as the interaction of variety and storage interval is concerned, the conjugal effect of both these factors could not create statistical variation over acidity level of amchur.

Table 2: Acidity (%) of amchur as influenced under the sole and interaction effects of variety of mango (*Mangifera indica* L.) and storage duration

Cultivars (V)	Storage interval days (D)							Mean
	0	30	60	90	120	150	180	
Mohanbhog	8.40	8.44	8.49	8.56	8.60	8.64	8.65	8.54
Phunia	8.58	8.60	8.62	8.66	8.69	8.70	8.73	8.65
Fazli	8.28	8.33	8.38	8.41	8.46	8.49	8.51	8.41
Bharathi	8.26	8.31	8.35	8.39	8.44	8.47	8.48	8.39
Ashwina	8.25	8.29	8.33	8.37	8.44	8.46	8.48	8.37
Mean	8.35	8.39	8.43	8.48	8.53	8.55	8.57	

Particulars	Variety (V)	Storage duration (D)	Variety X Storage duration (V X D)
S.Em. (±)	0.014	0.017	0.038
C.D. at 5% level	0.040	0.048	N.S.

Influence on reducing sugar content

The highest reducing sugar content (6.62%) had been measured in amchur prepared from variety Fazli, which differed significantly from amchur prepared from all other mango cultivars under present investigation (Table 3). The level of reducing sugar showed a direct relationship with storage duration, which increased proportionately with longer storage duration. Prabhakara *et al.* (2004) [9] and Jyothirmayi *et al.* (2006) [4] also observed a gradual increase in reducing

sugar content of tamarind powder during storage. The combined influence of variety and storage interval could not exert any considerable variation for reducing content of amchur.

Table 3: Reducing sugar (%) content of amchur as influenced under the sole and interaction effects of variety of mango (*Mangifera indica* L.) and various storage duration

Cultivars (V)	Storage interval days (D)							Mean
	0	30	60	90	120	150	180	
Mohanbhog	6.16	6.20	6.32	6.44	6.51	6.55	6.67	6.41
Phunia	6.02	6.12	6.23	6.38	6.41	6.46	6.54	6.31
Fazli	6.23	6.36	6.56	6.63	6.78	6.87	6.91	6.62
Bharathi	5.88	5.96	6.04	6.10	6.19	6.23	6.29	6.10
Ashwina	5.91	5.96	6.04	6.13	6.25	6.31	6.34	6.13
Mean	6.04	6.12	6.24	6.34	6.43	6.48	6.55	

Particulars	Variety (V)	Storage duration (D)	Variety X Storage duration (V X D)
S.Em. (±)	0.031	0.037	0.083
C.D. at 5% level	0.011	0.013	0.029

Influence on total sugar content

Among the mango varieties under present study Phunia was the best one to have 11.94% total sugar in amchur (Table 4). It was immediately followed by variety Mohanbhog, which resulted in 11.84% total sugar content in amchur. These two values differed significantly. Solitary influence of storage duration was effective enough to bring statistical variation for total sugar content of amchur. The highest total sugar content was registered at 0 DAS (11.99%) and it reduced to the lowest (11.37%) at 180 DAS. There was a decreasing trend in case of total sugars with the increasing time period of storage of ber power also had been observed by Kurdiya (1980) [5]. The total sugar content also failed to show any remarkable variation under the combined influence of variety and storage interval.

Table 4: Total sugar (%) content of amchur as influenced under the sole and interaction effects of variety of mango (*Mangifera indica* L.) and various storage duration

Cultivars (V)	Storage interval days (D)							Mean
	0	30	60	90	120	150	180	
Mohanbhog	12.09	12.06	11.95	11.88	11.70	11.64	11.53	11.84
Phunia	12.26	12.14	12.03	11.96	11.84	11.71	11.62	11.94
Fazli	12.00	11.95	11.91	11.78	11.62	11.54	11.47	11.75
Bharathi	11.88	11.74	11.55	11.47	11.38	11.28	11.19	11.50
Ashwina	11.73	11.65	11.55	11.43	11.35	11.18	11.06	11.42
Mean	11.99	11.91	11.80	11.70	11.58	11.47	11.37	

Particulars	Variety (V)	Storage duration (D)	Variety X Storage duration (V X D)
S.Em. (±)	0.014	0.016	0.036
C.D. at 5% level	0.038	0.046	N.S.

Influence on ascorbic acid content

Varietal differences in amchur preparation showed remarkable variation in ascorbic acid content of this product (Table 5). The highest and lowest ascorbic acid content of amchur had been shown as 12.19 mg/100 ml and 10.16 mg/100 ml with the use of Mohanbhog and Ashwina varieties during amchur preparation, respectively. The inherent characteristics of the mango varieties used in the present investigation might have played a significant role in evolving considerable variation in ascorbic acid content in amchur. The sole influence of storage duration also proved its capacity to bring about remarkable differences over ascorbic acid content

of amchur. The highest ascorbic acid levels at 0 DAS had been registered as 13.87 mg/100 ml, which subsequently decreased to 8.79 mg/100 ml at 180 DAS. The ascorbic acid content of amchur exhibited tangible variation under the influence of interaction of variety and storage duration. The significantly top most value for ascorbic acid content of 14.86 mg/100ml was observed for amchur prepared from Mohanbhog variety at 0 DAS. In contrast to this, the lowest ascorbic acid content of amchur (12.39 mg/100 ml) was documented at 180 DAS from variety Ashwina.

Table 5: Ascorbic acid (mg/100 g) content of amchur as influenced under the sole and interaction effects of variety of mango (*Mangifera indica* L.) and storage duration

Cultivars (V)	Storage interval days (D)							Mean
	0	30	60	90	120	150	180	
Mohanbhog	14.86	13.95	12.71	11.96	11.33	10.65	9.87	12.19
Phunia	14.51	13.66	12.42	11.58	10.87	10.26	9.06	11.77
Fazli	13.67	12.59	11.93	11.01	10.53	9.47	8.25	11.06
Bharathi	13.94	13.09	12.36	11.29	10.51	10.22	9.07	11.50
Ashwina	12.39	11.88	10.95	10.03	9.71	8.44	7.69	10.16
Mean	13.87	13.03	12.07	11.17	10.59	9.81	8.79	

Particulars	Variety (V)	Storage duration (D)	Variety X Storage duration (V X D)
S.Em. (±)	0.009	0.010	0.023
C.D. at 5% level	0.024	0.029	0.064

Influence on overall acceptability

Overall acceptability score of amchur was measured with the combined assessment of taste, flavour and colour. Mohanbhog was come out as the best variety for amchur preparation from overall acceptability point of view, with a score of 7.60 (Table 6). In contrast to this, Bharathi could gather the least score for this parameter (7.45). The highest content of ascorbic acid along with fairly high levels of acidity, reducing and total sugar content in variety Mohan bhog might have contributed for the top quality of amchur preparation. With the increase in storage duration the overall acceptability exhibited a significantly declining trend for amchur. The lowest score for this (7.09) was obtained from 180 DAS, whereas it was estimated as the highest during the initial stage (7.98). As a very good supportive evidence to this result the declining trend of overall acceptability also have been reported by Rao *et al.* (2008) [10], who showed reduction

in overall quality of amchur, made from Neelum variety of mango, from 8.20±0.44 to 7.50±0.78 from initial stage to 6 months after storage. The effect of interaction of variety and storage interval was insignificant with respect to create variation on the overall acceptability score of amchur.

Table 6: Overall acceptability score of amchur as influenced under the sole and interaction effects of variety of mango (*Mangifera indica* L.) and storage duration

Cultivars (V)	Storage interval days (D)							Mean
	0	30	60	90	120	150	180	
Mohanbhog	8.06	7.93	7.74	7.59	7.44	7.30	7.17	7.60
Phunia	8.02	7.90	7.71	7.55	7.38	7.26	7.14	7.57
Fazli	7.89	7.75	7.63	7.46	7.28	7.11	7.00	7.50
Bharathi	7.99	7.87	7.65	7.50	7.34	7.19	7.09	7.45
Ashwina	7.94	7.81	7.69	7.50	7.31	7.17	7.07	7.52
Mean	7.98	7.85	7.68	7.52	7.35	7.21	7.09	

Particulars	Variety (V)	Storage duration (D)	Variety X Storage duration (V X D)
S.Em. (±)	0.022	0.027	0.059
C.D. at 5% level	0.064	0.075	N.S.

Influence on microbial load

For marking the bacterial population in amchur, the counting of 10⁻⁴, 10⁻⁵ and 10⁻⁶ levels of colony forming units were carried out (Table 7). From the experimental results it had been observed that from initial stage upto 60 DAS no colony was formed, irrespective of varieties. At the later stages the bacterial units increased gradually, which showed very fast regeneration level in between 150 DAS to 180 DAS. The least numbers of colony i.e. 6.00 X 10⁻⁴, 4.00 X 10⁻⁵ and 2.00 X 10⁻⁶ were developed in amchur prepared from Mohanbhog variety of mango during 180 DAS. With respect to the development of fungal population the colony forming units were studied at 10⁻², 10⁻³ and 10⁻⁴ categories during the whole storage duration (Table 8). The notable fact in this aspect is that there were a very negligible growth of fungal unit had been visualized upto 90 DAS, but from there after the fungal population showed a rapid growth rate. Relatively lower growth of fungal population as 2.00 X 10⁻², 1.00 X 10⁻³ and 1.00 X 10⁻⁴ and 4.00 X 10⁻², 3.00 X 10⁻³ and 1.00 X 10⁻⁴ were documented in the amchur prepared from Mohanbhog were detected at 150 DAS and 180 DAS, respectively.

Table 7: Bacterial population (cfu/g) as detected in amchur under the sole influence and interaction effects of variety of mango (*Mangifera indica* L.) and storage duration

Cultivars (V)	Storage interval days (D)																				
	Initial			30			60			90			120			150			180		
	Type of C.F.U.			Type of C.F.U.			Type of C.F.U.			Type of C.F.U.			Type of C.F.U.			Type of C.F.U.			Type of C.F.U.		
	10 ⁻⁴	10 ⁻⁵	10 ⁻⁶	10 ⁻⁴	10 ⁻⁵	10 ⁻⁶	10 ⁻⁴	10 ⁻⁵	10 ⁻⁶	10 ⁻⁴	10 ⁻⁵	10 ⁻⁶	10 ⁻⁴	10 ⁻⁵	10 ⁻⁶	10 ⁻⁴	10 ⁻⁵	10 ⁻⁶	10 ⁻⁴	10 ⁻⁵	10 ⁻⁶
Mohanbhog	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.00	ND	ND	2.00	1.00	ND	3.00	3.00	1.00	6.00	4.00	2.00
Phunia	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.00	ND	ND	6.00	2.00	2.00	9.00	5.00	4.00	12.00	7.00	6.00
Fazli	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.00	ND	ND	4.00	2.00	1.00	5.00	4.00	3.00	9.00	6.00	3.00
Bharathi	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.00	ND	ND	5.00	3.00	1.00	8.00	5.00	3.00	10.00	7.00	5.00
Aswina	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.00	2.00	ND	5.00	3.00	2.00	8.00	5.00	4.00

ND-Not Detected, C.F.U. -Colony Forming Unit

Table 8: Fungal population (cfu/g) as detected in amchur under the sole influence and interaction effects of variety of mango (*Mangifera indica* L.) and storage duration

Cultivars (V)	Storage interval days (D)																				
	Initial			30			60			90			120			150			180		
	Type of C.F.U.			Type of C.F.U.			Type of C.F.U.			Type of C.F.U.			Type of C.F.U.			Type of C.F.U.			Type of C.F.U.		
	10 ⁻²	10 ⁻³	10 ⁻⁴	10 ⁻²	10 ⁻³	10 ⁻⁴	10 ⁻²	10 ⁻³	10 ⁻⁴	10 ⁻²	10 ⁻³	10 ⁻⁴	10 ⁻²	10 ⁻³	10 ⁻⁴	10 ⁻²	10 ⁻³	10 ⁻⁴	10 ⁻²	10 ⁻³	10 ⁻⁴
Mohanbhog	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.00	1.00	ND	2.00	1.00	1.00	4.00	3.00	1.00
Phunia	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.00	ND	ND	5.00	2.00	2.00	9.00	7.00	6.00	14.00	10.00	6.00
Fazli	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.00	ND	ND	3.00	2.00	2.00	7.00	3.00	4.00	10.00	6.00	4.00
Bharathi	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.00	ND	ND	4.00	3.00	1.00	8.00	5.00	3.00	12.00	7.00	5.00
Aswina	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.00	1.00	ND	4.00	2.00	1.00	7.00	3.00	3.00

ND-Not Detected, C.F.U. -Colony Forming Unit

Conclusion

The overall assessment of quality of amchur revealed that with respect to conjugal study of all these parameters, the variety Mohanbhog had a definite positive impact over the end product. However, the maximum overall acceptability score had been gathered by amchur manufactured from Mohanbhog variety. With the advancement of the length of storage upto 180 days, moisture and reducing sugar content and acidity percentage showed a gradual increase, whereas total sugar and ascorbic acid content and overall acceptability score revealed continuous decreasing trend.

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