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P Sarada
Department of Post Harvest Technology, College of Horticulture, Venkataramannagudem, Dr. Y.S.R Horticultural University, Andhra Pradesh, India

V Sudha Vani
Department of Post Harvest Technology, College of Horticulture, Venkataramannagudem, Dr. Y.S.R Horticultural University, Andhra Pradesh, India

R Rajya Lakshmi
Department of Post Harvest Technology, College of Horticulture, Venkataramannagudem, Dr. Y.S.R Horticultural University, Andhra Pradesh, India

V Suchitra
Department of Post Harvest Technology, College of Horticulture, Venkataramannagudem, Dr. Y.S.R Horticultural University, Andhra Pradesh, India

Dr. Salomi Suneetha
Department of Post Harvest Technology, College of Horticulture, Venkataramannagudem, Dr. Y.S.R Horticultural University, Andhra Pradesh, India

K Venkata Subbaiah
Department of Post Harvest Technology, College of Horticulture, Venkataramannagudem, Dr. Y.S.R Horticultural University, Andhra Pradesh, India

Correspondence
P Sarada
Department of Post Harvest Technology, College of Horticulture, Venkataramannagudem, Dr. Y.S.R Horticultural University, Andhra Pradesh, India

Influence of variety and drying methods on yield and quality of the Amchur prepared from fallen unripe mango fruits

P Sarada, V Sudha Vani, R Rajya Lakshmi, V Suchitra, Dr. Salomi Suneetha and K Venkata Subbaiah

Abstract
The present investigation entitled "Influence of variety and drying methods on yield and quality of the amchur prepared from fallen unripe mango fruits" was carried out at Post harvest technology Laboratory, College of Horticulture, Venkataramannagudem, Dr. Y.S.R Horticultural University, West Godavari District of Andhra Pradesh during 2016-17. The experiment was laid out in Factorial CRD concept with three replications and 10 treatments. The experiment comprises of amchur prepared from fallen unripe mango fruits *i.e*., Chinnarasam, Nallarasam, Totapuri, Neelum and Local by using two different drying methods *viz*., sun drying and tray drying. The highest value of total sugars (16.05%), better retention of ascorbic acid (132.95mg 100 g^{-1}), less moisture content (4.87%) and acidity (0.47%) were recorded in Chinnarasam variety dried by tray drying was nutritionally good. Among the drying methods, tray drying was best in terms of quality.

Keywords: Amchur, fallen fruits, fruit powders

Introduction
The mango (*Mangifera indica* L.) is a juicy stone fruit belonging to the family Anacardiaceae and genus *Mangifera*, consisting of numerous tropical fruiting trees, cultivated mostly for edible fruit. It is one of the delicious fruit of commercial importance. Due to its high palatability, excellent taste, attractive colour, pleasant aroma, flavour, exemplary medicinal and nutritive values, it is said to be king of tropical fruits (Singh *et al.*, 1990) [12]. India ranks first among world's mango producing countries accounting for nearly about 50% of the world's mango production. In India it is cultivated in an area of 2.2 million hectares with 19.69 million tons of production. Andhra Pradesh ranks first with respect to area *i.e*., 3.15 lakh ha and second in production with 28.22 lakh tons (NHB 2015-16). Mango is one of the fruits which can be utilized at all stages of maturity, from immature unripe stage to ripened stage. It has to face discouraging elements like strong winds, hail storms, nutritional imbalance, lack of fertilization, embryo abortion, and pest and disease pressure *etc*., (Malte *et al*., 2009) [4] during its growth and development. This leads to heavy fruit drop before reaching maturity, which causes serious loss to grower. Such losses can be minimized to a greater extent by utilizing the dropped fruits in preparation of value added products. These unripe or green fruits are preserved in different ways in order to increase the returns by utilizing the fallen fruits at green stage and can be used for preparation of processed products like amchur, mango slices, pickles and beverages.

Amchur is rich in iron content, vitamin A and vitamin E. It combats acidity and improves digestion to the flavour to curries, chutneys, soups. It is used as spice in South Asian recipes. Drying is an essential process for food industry in order to preserve food quality and food stability by lowering the moisture content. Usually the dropped immature mangoes are dried in direct sunlight for preparation of amchur. Sun drying takes 16–18 hours for complete drying (Teotia and Pruthi, 1987) [13, 14]. Though, the amchur prepared by using sun drying method was poor quality so, we need to improve the quality of amchur. Hence the present investigation was to find out the best variety and drying method for preparation of amchur.

Material and Methods

The present investigation was conducted in the Post Harvest Technology Laboratory, College of Horticulture, Venkataramannagudem, Dr. Y.S.R Horticultural University, West Godavari District of Andhra Pradesh during 2016-17. The laboratory experiment was carried out by following a Factorial Completely Randomized Design with three replications and ten treatments *viz*., Amchur prepared from Chinnarasam, Nallarasam, Totapuri, Neelum and Local by sun and tray drying and observations were recorded on the initial day, 60th and 120th day of storage. The mango fruits were taken at the time of ½ to ¾ th maturity stage.

The fallen unripe mango fruits were collected, peeled and then cut into thin slices, immersed in 0.05% KMS solution and dried under different methods (sun drying and tray drying). The dried slices are grounded to powder and packed in LDPE bags (200 guage) and stored at room temperature. Fallen mango fruits of Chinnarasam, Nallarasam, Totapuri, Neelum and local varieties were collected from the mango orchard. Fruits which are unripe and free from insect damages and diseases were selected for making the nutritious amchur. Ascorbic acid content of fresh mango, amchur was estimated by using the standard procedure as suggested by Ranganna (1986) [9]. Titrable acidity was analyzed by titrating a known aliquot of sample against standard 0.1 N NaOH using phenolphthalein as indicator. The percent total sugars in fresh mango, amchur were determined by Lane and Eynon method (AOAC, 1965) [1].

Results and Discussion

The observations recorded on physico-chemical parameters of fresh mango fruits are presented in Table 1. Among the varieties, Chinnarasam variety recorded the maximum average weight of the fruit (201.48 g), TSS (10.86º Brix), ascorbic acid content (37.35 mg 100g $^{-1}$), total sugars (5.29%), reducing sugars (3.35%), non reducing sugars (1.94%) and lowest moisture content (76.16%), acidity (0.23%) where as local variety recorded the lowest average weight of the fruit (110.48 g), TSS (9.62º Brix), ascorbic acid (21.69 mg 100g $^{-1}$), total sugars (3.53%), reducing sugars (2.64%) and non reducing sugars (0.89%) and highest moisture content (88.52%), acidity (0.47%).Similar results were found with unripe mango fruits for pickle preparation by Ray (2008) [10], Sastry *et al*. (1974) [11] and Palaniswamy *et al*. (1974) [7].

In the present investigation, in all treatments Chinnarasam variety by tray drying was best compared to remaining treatments. Lowest moisture content (4.56%) was recorded in Chinnarasam variety by tray drying which was followed by amchur prepared from Chinnarasam variety by sun drying (4.87%) was presented in Table 2.The increase in moisture content during storage from initial to 120th day as observed in the present study could be attributed to hygroscopic nature of amchur and absorption of moisture from the atmosphere. Similar results were found in ripe banana powder was reported by Evelin *et al*. (2007) [3], Dabhade and Khedkar (1980 b) [2] and Teotia *et al*. (1987) [13, 14] in mango powder and Rai and Mishra (2001) [8] in bael powder.

Significant reduction (Table 3) was noticed in ascorbic acid content of amchur in all the treatments. The retention of ascorbic acid content was highest *i.e*., 165.53 mg 100g^{-1} in the amchur prepared with Chinnarasam variety and dried in tray drying on the initial day of storage which was followed by followed by amchur prepared from Totapuri variety by tray drying (156.73 mg 100g^{-1}). Decrease in ascorbic acid content during storage might be due to oxidation or irreversible conversion of L-ascorbic acid into dehydro ascorbic acid oxidase (ascorbimase). During storage period decrease in ascorbic content was in ripe banana powder was reported by Evelin *et al*. (2007) [3] in banana flour by Mandalik *et al*. (2009) [5], by Dabhade and Khedkar (1980 b) [2] and Teotia *et al*. (1987) [13, 14] and in bael powder by Rai and Mishra (2001) [8].

There was a gradual decrease (Table 4) in titrable acidity throughout the storage period. Titrable acidity was minimum *i.e*., 0.13% in the amchur prepared with Chinnarasam variety and dried in tray drying on 120th day of storage which was followed by amchur prepared from Chinnarasam variety by sun drying (0.15%).The decrease in rate of acidity of the powder was influenced by various processing techniques during storage period. This might be due to reduction of organic acid by ascorbic acid degradation and increase in sugar content of powder. Similar results were also observed by Evelin *et al*. (2007) [3] and Mandalik *et al*. (2009) [5], with banana powder and banana flour and Dabhade and Khedkar (1980 b) [2] and Teotia *et al*. (1987) [13, 14] with mango powder.

There was a slight increase in the total sugar content during storage at ambient conditions. The total sugar content was maximum *i.e.,* 24.83% in the amchur prepared from Chinnarasam variety and dried in the tray drying which was followed by amchur prepared from Totapuri variety by tray drying (24.57%) on 120th day of storage was presented in Table 5. Increase in total sugar content during storage period might be due to accelerated hydrolysis of insoluble polysaccharides and other carbohydrates polymer and increased degree of inversion of sugar. Similar increase was also reported by Evelin *et al*. (2007) [3] in banana flour, Dabhade and Khedkar (1980b) [2] and Teotia *et al*. (1987) [13, 14] in mango powder.

Table 1: Physico-chemical characteristics of fresh mango from fallen unripe fruit used for preparation of amchur

Variety	Average weight of the fruit (g)	TSS (ºBrix)	Acidity (%)	Ascorbic acid (mg100^{-1})	Moisture content (%)	Total sugars (%)	Reducing sugars (%)	Non reducing sugars (%)
V_1 (Chinnarasam)	201.48	10.86	0.23	37.35	76.16	5.29	3.35	1.94
V_2 (Nallarasam)	195.36	10.23	0.32	25.64	79.33	4.73	3.10	1.63
V_3 (Totapuri)	194.X3	10.67	0.25	25.27	77.40	5.12	3.24	1.88
V_4 (Neelum)	177.15	9.75	0.39	28.19	84.36	4.14	2.85	1.29
V_5 (Local)	110.48	9.62	0.47	21.69	88.52	3.53	2.64	0.89

Table 2: Effect of varieties and drying methods on moisture content (%) of amchur from fallen unripe fruits during storage at ambient conditions

Variety	Initial			60th			120th		
	Sun drying	Tray drying	Mean	Sun drying	Tray drying	Mean	Sun drying	Tray drying	Mean
Chinnarasam	4.87	4.56	4.71	6.15	5.85	6.00	7.53	7.05	7.29
Nallarasam	6.03	5.36	5.70	6.94	6.77	6.86	8.65	8.23	8.44
Totapuri	5.94	5.84	5.89	6.85	6.49	6.67	8.37	8.15	8.26
Neelum	6.76	6.49	6.63	7.52	7.38	7.45	9.39	9.15	9.27
Local	7.05	6.94	6.99	7.85	7.46	7.65	9.67	9.48	9.58
Mean	6.12	5.84		7.06	6.79		8.41	8.73	
	S.Em±	CD at (0.05)		S.Em±	CD at (0.05)		S.Em±	CD at (0.05)	
V	0.010	0.027		0.011	0.033		0.011	0.033	
D	0.006	0.018		0.007	0.021		0.007	0.021	
V×D	0.014	0.040		0.016	0.046		0.016	0.047	

Table 3: Effect of varieties and drying methods on ascorbic acid (mg $100g^{-1}$) of amchur from fallen unripe fruits during storage at ambient conditions

Variety	Initial			60th			120th		
	Sun drying	Tray drying	Mean	Sun drying	Tray drying	Mean	Sun drying	Tray drying	Mean
Chinnarasam	132.95	165.53	149.24	112.77	138.20	125.49	100.86	132.13	116.50
Nallarasam	120.93	153.80	137.36	96.86	125.65	111.25	89.94	102.93	96.39
Totapuri	125.47	156.73	141.10	104.87	137.80	121.33	96.76	108.47	102.61
Neelum	114.65	148.76	131.70	93.86	127.57	110.72	73.78	108.57	91.18
Local	105.65	143.43	124.54	86.42	115.67	101.04	71.87	103.27	87.57
Mean	119.93	153.65		98.96	128.98		86.62	111.07	
	S.Em±	CD at (0.05)		S.Em±	CD at (0.05)		S.Em±	CD at (0.05)	
V	0.179	0.527		0.186	0.550		0.137	0.403	
D	0.113	0.334		0.118	0.348		0.086	0.255	
V×D	0.253	0.746		0.264	0.777		0.193	0.569	

Table 4: Effect of varieties and drying methods on acidity (%) of amchur from fallen unripe fruits during storage at ambient conditions

Variety	Initial			60th			120th		
	Sun drying	Tray drying	Mean	Sun drying	Tray drying	Mean	Sun drying	Tray drying	Mean
Chinnarasam	0.47	0.35	0.41	0.22	0.18	0.20	0.15	0.13	0.14
Nallarasam	1.32	0.78	1.16	1.12	0.53	0.82	0.70	0.22	0.46
Totapuri	1.20	0.77	0.98	0.98	0.36	0.67	0.33	0.20	0.26
Neelum	1.37	0.87	1.09	1.15	0.54	0.85	0.95	0.33	0.64
Local	1.54	1.18	1.27	1.17	1.13	1.15	1.00	0.98	0.99
Mean	1.18	0.79		0.93	0.55		0.62	0.37	
	S.Em±	CD at (0.05)		S.Em±	CD at (0.05)		S.Em±	CD at (0.05)	
V	0.008	0.024		0.002	0.007		0.014	0.040	
D	0.005	0.015		0.002	0.006		0.009	0.026	
V×D	0.011	0.033		0.003	0.011		0.019	0.057	

Table 5: Effect of varieties and drying methods on total sugars (%) of amchur from fallen unripe fruits during storage at ambient conditions

Variety	Initial			60th			120th		
	Sun drying	Tray drying	Mean	Sun drying	Tray drying	Mean	Sun drying	Tray drying	Mean
Chinnarasam	16.05	18.64	17.34	20.53	23.13	21.83	22.24	24.83	23.54
Nallarasam	14.19	15.34	14.77	18.57	19.75	19.16	20.16	21.38	20.77
Totapuri	15.37	18.26	16.81	19.76	22.81	21.28	21.42	24.57	22.99
Neelum	13.85	14.07	13.96	18.14	18.37	18.26	19.68	19.95	19.82
Local	10.25	11.27	10.76	14.49	15.54	15.02	15.94	17.05	16.50
Mean	13.94	15.52		18.30	19.92		19.89	21.56	
	S.Em±	CD at (0.05)		S.Em±	CD at (0.05)		S.Em±	CD at (0.05)	
V	0.012	0.032		0.028	0.081		0.024	0.071	
D	0.008	0.024		0.018	0.047		0.015	0.045	
V×D	0.017	0.050		0.039	0.112		0.034	0.100	

Among the different varieties, amchur prepared from Chinnarasam variety and dried in tray drying was most acceptable throughout the storage period from initial to 120th day of storage at ambient temperature, as it recorded appreciable levels of sugars, ascorbic acid content, acidity, moisture content. Among the drying methods, tray drying was best as it showed the nutritionally rich with superior quality attributes and high acceptable even after four months of storage with hygienic conditions without much loss of nutritional qualities of the product. Tray drying provides constant temperature, relative humidity, saves energy and maintains high quality of the product *i.e*., nutritionally good with colour, flavour, taste and texture when compared to sun drying.

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