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Vishakha
Department of Food Science and Technology, College of Horticulture and Forestry, Neri Hamirpur, Himachal Pradesh, India

Verma AK
Department of Food Science and Technology, College of Horticulture and Forestry (Dr YS Parmar University of Horticulture and Forestry) Neri-Hamirpur, Himachal Pradesh, India

Shivani
Department of Food Science and Technology, College of Horticulture and Forestry (Dr YS Parmar University of Horticulture and Forestry) Neri-Hamirpur, Himachal Pradesh, India

Thakur P
Department of Food Science and Technology, College of Horticulture and Forestry (Dr YS Parmar University of Horticulture and Forestry) Neri-Hamirpur, Himachal Pradesh, India

Corresponding Author:
Vishakha
Department of Food Science and Technology, College of Horticulture and Forestry, Neri Hamirpur, Himachal Pradesh, India

Development and quality evaluation of chutney from mango seed kernels

Vishakha, Verma AK, Shivani and Thakur P

Abstract
The suitability of utilizing seedling mango seed kernels evaluated for the preparation of Chutneys consisting of three different recipes *viz*., storage of kernels for 30 days in 15% salt solution in all the three recipes followed by without blanching and 80% TSS, blanching for 2 minutes and 70% TSS and blanching for 2 minutes and 80% TSS in recipe 1, recipe 2 and recipe 3, respectively. Out of different recipes, chutney prepared from kernels stored for 30 days in 15% salt followed by Blanching for 2 minutes and 80% sugar was found most appropriate on basis of sensory acceptability having 50.40-51.14% protein, 16.20-24.50% fat, 087-0.94% crude fibre, 0.94-1.17% ash, 50.07-50.47 °B TSS, 10.18-10.45% salt, 4.22-4.50 pH, 1.45-1.71% titratable acidity, 2.32-4.17 mg/100 g ascorbic acid, 63.27-64.04% carbohydrates, 0.07-0.26% tannin, 191.00-207.33mg/100g phenol, 35.07-44.44.83% total sugars and 25.13-26.17% reducing sugars during 90 days storage at ambient temperature. However, the storage intervals exhibited non-significant effect in ascorbic acid, carbohydrates, tannin content, total sugars, reducing sugars, fat content, ash and crude fibre.

Keywords: Mango seed kernels, chutney, blanching, storage

Introduction
Mango belonging to the family *Anacardiaceae* has a delicious taste, aroma and high nutritional value. Besides direct consumption, more than half of the harvested mangoes are utilized in the preparation of juice, nectar, puree, squash, slices, jam, and pickles (Nadeem *et al.*, 2016) [22]. Consumption of fresh fruit by individuals and large-scale processing by the pulp industry has resulted into a significant quantity of mango seeds as a by-product (Athiappan, 2020 and Puravankara, 2000) [4, 15]. However, use of mango seed kernels for the extraction of oil and phytochemicals may be economically profitable and environmentally safe. Apart from oil, mango seed kernels contain a congregation of several bioactive compounds that include carotenoids, dietary fiber, vitamin C, polyphenols, phytosterols, and tocopherols with high antioxidant activity and health benefits (Jahurul *et al.*, 2015) [9]. These compounds have been demonstrated to be crucial in the Ayurvedic medicinal system for centuries. In the future, the exploration of these natural phytochemicals will be indispensable since their extraction has proven to be economical and practical (Kaur *et al.*, 2020) [23]. Although enough information is available on the nutritional composition of mango seed kernels, that may be attributed to vary due to varietal and geographical differences. Like mango pulp, the seed is rich in nutrients and has been used for developing various value-added products. The mango seed kernels contains high amounts of carbohydrates, protein, lipids, and several minerals (Ediriweera *et al.*, 2017, Ribeiro *et al.*, 2010 and O'Shea *et al.*, 2012) [6, 14, 16]. Similar to the pulp and the peel, the mango seed kernel is also considered a prospective source of polyphenols with potent antioxidant activity. In India, the whole mango tree, including the stem, bark, leaves, flowers, and fruit, has been widely used as an ancient traditional medicine to treat various diseases and discomforts. All parts of the mango tree contain essential bioactive compounds, such as mangiferin, quercetin, catechins, and kaempferol. In recent years, many researchers have explored the ethnopharmacological and pharmacological efficacies of the various bioactive constituents of mango fruit. This evidence emphasizes the importance of mango by-products in the treatment of various chronic diseases, including diabetes, cancer, asthma, hypertension, and hemorrhage in the lungs and intestine, having higher efficiency and fewer side effects. Different parts of the mango offer different benefits, such as anti-inflammatory, antioxidant, anticancer, anti-diabetic, antimicrobial, anti-hyperlipemic, and immunomodulatory activities (Ediriweera *et al.*, 2017, Ajila and Rao, 2013 and Lauricella *et al.*, 2017) [6, 1, 12]. The purpose of current study is to utilized mango seed kernels for value added products.

Materials and Methods

The present study was carried out at the Department of Food Science and Technology, College of Horticulture and Forestry, Dr YSP University, Solan (H.P) during the year 2020-2021.

Raw Material

The stones of mango fruits (*Mangifera indica L.*) were collected from local farmers of Neri, Hamirpur district of Himachal Pradesh and used in these studies.

Preparation of chutney

The mango seed kernels were washed in running water to remove dirt and dust particles. They were cut into slices and blanched to reduce tannin for chutney preparation. Then the slices were grated to thin shreds for preparation of chutney. After getting the shreds, the requisite quantity of ingredients was added as per the recipe. To the fruit pulp (1000 g) 100 ml water was added and cooked with ginger (50 g) for 5-10 minutes then sugar (800 g) was mixed and the mixture was left for 10-15 minutes. To this mixture, salt (45 g) and ground spices like cumin (15 g) were added while cooking. When the desired consistency has been reached glacial acetic acid (40 ml) and sodium benzoate (1 g) were added and further cooked for 2 minutes to obtain semi-solid mango seed kernels chutney of uniform consistency. The products were packed in PET jars. Care was taken to achieve accuracy in the quality and quantity of the ingredients, method of preparation, time, temperature and the number of portions.

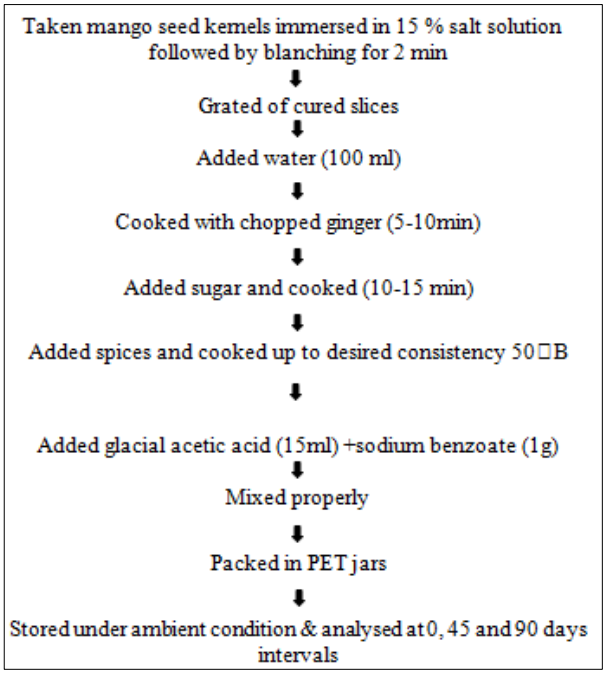

Fig 1: Flow sheet for preparation of mango seed kernels chutney

Proximate Analyses

Protein

Weighed 4 to 6 g of sample and transferred to Kjeldahl flask. Added about 1-2g of digestion mixture in an inclined position, on the stand in the digestion chamber and digest. Added few drops of perchloric acid to decrease the time of digestion and continue heating till solution become clear. Transferred the clear solution to 100 ml volumetric and made the digest to 100 ml. Carried out a blank digestion without the sample. Added 5 ml of the sample solution and 10 ml of 30% sodium hydroxide in a distillation apparatus for distillation. Taken 10 ml of 2% boric acid containing 2 drops of mixed indicator in conical flask and dip the end of distillation unit in the solution to absorb the evolved ammonia and collect the distillation till it is 30 ml. Titrate the distillate against 0.01 N HCl. The appearance of pink colour indicates end point. Run the blank for same. Distillation and titration should be completed within 5-8 minutes (Ranganna, 2014) [24].

$$\text{Nitrogen (\%)} = \frac{(\text{Sample Titre} - \text{Blank Titre}) \times \text{normality of HCl} \times 14 \times \text{volume made up of the digest} \times 100}{\text{Aliquot of the digest taken} \times \text{Sample weight} \times 1000}$$

I ml of 0.01 N HCl = Neutralized 0.0014 g of nitrogen
Protein (%) = nitrogen (%) x 6.25

Fat

It was determined by extracting 2-5g of sample in petroleum ether using a soxhlet extraction apparatus. Extraction of sample was done for 16 hours. Thereafter, ether was removed by evaporation, the extracted fat was weighed and percentage of ether-soluble material was calculated on dry weight basis (Ranganna, 2014) [24] was calculated as:

$$\text{Fat (\%)} = \frac{\text{Weight of ether soluble material}}{\text{Weight of sample}} \times 100$$

Crude Fibre

For estimation of crude fibre in mango kernels and products method as detailed in AOAC (1980) [2] was used. Defatted sample of mango seed kernels (5gm) after simultaneous digestion with dilute sulphuric acid and sodium hydroxide was filtered through Buchner funnel under suction. The loss in weight representing crude fibre was calculated and expressed as per cent (w/w)

$$\text{Crude fibre (\%)} = \frac{\text{Weight of crucible with content after ignition} - \text{weight of crucible}}{\text{Weight of sample (g)}} \times 100$$

Ash content

Total ash content of mango seed kernels and prepared products was estimated gravimetrically by taking known weight of samples in tared silica crucibles. The dried samples after moisture determination were slowly heated over a hot plate until the bulk of organic matter was burnt, then the crucibles were kept in a muffle furnace at 550 °C toobtain a carbon free white ash with a constant weight. Ash content of sample was expressed as per cent w/w (Ranganna, 2014) [24] and per cent ash content was calculated by using the following formula:

$$\text{Ash (\%)} = \frac{(\text{Weight of crucible} + \text{Ash}) - \text{Weight of crucible}}{\text{Weight of sample taken}} \times 100$$

Chemical Analysis

Total soluble solids (TSS)

The total soluble solids (TSS) were determined with the help of hand refractometer of range 0-32 °B, 30-60 °B, 58-92 °B. The samples were crushed in pestle and mortar and their extract was taken for observation. The TSS was recorded by placing 1-2 drops of extract on the prism of a hand refractometer. The results were expressed as °Brix (Ranganna, 2014) [24].

pH

The pH of the extracted mango seed kernels and prepared products after dilution was measured using an automatic pH meter (Deluxe pH meter model 101) after calibration of the instrument with standard buffer solution of pH 7 (AOAC, 1995) [3].

Titratable acidity

The titratable acidity of mango seed kernels and its products was assessed by the standard method of Ranganna (2014) [24]. 10 g of sample was diluted with 100 ml of distilled water. Further, 10ml of this aliquot was titrated against 0.1N NaOH solution to a pink end point using 0.1% phenolphthalein indicator. The acidity as citric acid was calculated from the following expression:

$$\text{Crude fibre (\%)} = \frac{\text{Weight of crucible with content after ignition} - \text{weight of crucible}}{\text{Weight of sample (g)}} \text{ x } 100$$

Ascorbic acid

The ascorbic acid content was assessed by the method of Ranganna (2014) [24]. 10g of sample was mixed with 3 per cent metaphosphoric acid to make 100ml by using metaphosphoric acid followed by filtration through filter paper. 5ml of the aliquot was taken and titrated with standard dye (2, 6- dichlorophenol- indophenol dye) to a faint pink colour end point. Ascorbic acid (mg/100g) in the sample was calculated using following expression:

$$\text{Titratable acidity (\%)} = \frac{\text{Titre value} \times \text{Normality of alkali} \times \text{Volume made up} \times \text{Equivalent weight of acid}}{\text{Volume of sample taken} \times \text{Volume of aliquot taken} \times 1000} \times 100$$

Reducing Sugars

A known weight of sample (25 g/ml) was taken in a 250 ml volumetric flask and 100 ml water was added to it. Solution was neutralized with 1 N NaOH and 2 ml of 45% lead acetate was added to it and kept for 10 min. Excess of lead acetate was removed from the sample by using 2 ml of 22% potassium oxalate in 250 ml volumetric flask. After diluting it up to the mark, the solution was filtered and clear filtrate was taken to estimate reducing sugars by titrating against a known quantity of Fehling's A and Fehling's B solution using methylene blue as an indicator (Lane and Eynon, 1923) [11]. Reducing sugars were estimated as per cent and calculated as given below

$$\text{Reducing sugars (\%)} = \frac{\text{mg of invert sugar} \times \text{dilution}}{\text{Titre value} \times \text{Weight or volume of sample}} \text{ x } 100$$

Total Sugars

Total sugars were estimated by adding 5 g of citric acid to 50 ml filtrate from the reducing sugar estimation and heating it for 10 min., then neutralizing the sample with 1N NaOH using phenolphthalein as indicator and making volume 250 ml in volumetric flask with distilled water. The total sugars were estimated as per cent and calculated as given as under:

a) % Total sugars as invert sugars = Calculated as in (Reducing sugars) making use of titre value obtained in the determination of total sugars after inversion
b) % Sucrose = (% total invert sugars -% reducing sugars) x 0.95
c) % Total sugars = (% reducing sugars +% sucrose)

Result and Discussion

Proximate analysis of mango seed kernels

The data presented in Table 1 indicate proximate analysis of mango seed kernels. The average moisture, protein, fat, crude fibre and ash content in mango kernels were recorded as 53.7%, 6.37%, 8.93%, 1.47% and 1.03%, respectively. Similar results were recorded by Mwaurah *et al.* (2020) [13] in mango seed kernels who has reported 6.36 to 10.02% crude protein, 6 to 15.2% fat, 1.46 to 3.71% ash content and 0.26 to 4.69% crude fibre and Gumte *et al.*, (2018) [7] found that mango seed kernels consist of 10.02% crude protein, 9.87% fat, 2.03% ash content and 2.23% crude fibre.

Table 1: Proximate analysis of mango seed kernels

Parameters	Percentage
Protein (%)	6.37
Fat (%)	8.93
Crude fibre (%)	1.47
Ash (%)	1.03

Proximate analysis of mango seed kernel chutney

The data of proximate analysis of mango seed kernels showed in Table 1.

Effect on Protein (%)

It was found that R1 has maximum protein content, followed by R2 while, R3 has minimum protein content. The experiment showed that the protein content varied with the storage interval. R1 contain 50.81%, R2 contain 50.73% while R3 contain 50.55%. Protein percent of mango seed kernels chutney was decreased from 51.02 to 50.41% during storage interval might due to breakdown of amino acids. Similar results were reported by Singhania *et al.* (2020) [17] in wood apple chutney and Thakur *et al.* (2017) [20] in wild pomegranate chutney.

Effect on Fat (%)

The maximum fat content was recorded in recipe R1 while minimum fat content was observed in recipe R3 of mango seed kernel chutney. Data showed that R1 contain 20.11%, R2 contain 20.03% while R3 contain 20.02% fat content. The decrease in fat content varied from 24.34 to 16.36%. Similar result was reported by Singhania *et al.* (2020) [17] in wood apple chutney and Husaini *et al.* (2019) [18] in mango chutney.

Effect on Crude fibre (%)

The experimental data showed that R1 has maximum while R2 and R3 has minimum crude fibre. R1 contain 0.91% while R2 and R3 contain 0.90%. Crude fibre percent of mango seed kernels chutney was decreased from 0.93 to 0.87% during storage interval.

Effect on Ash (%)

It was found that R3 and R2 has maximum ash content, followed by R1 has minimum protein content. The experiment showed that the ash content decreased with the storage interval. R1 contain 1.04%, R2 contain 1.05% while R3 also contain 1.05% ash content. Ash content of mango seed kernels chutney was decreased from 1.15 to 0.95% during storage interval.

Table 2: Changes in protein, fat, crude fibre and ash of mango seed kernels chutney during storage at ambient temperature

Parameters	Recipe	Storage Intervals			
		0 Days	45 Days	90 Days	Mean
Protein (%)	R1	51.14	50.86	50.43	50.81
	R2	51.04	50.73	50.41	50.73
	R3	50.87	50.40	50.40	50.55
	Mean	51.02	50.67	50.41	
Fat (%)	R1	24.50	19.40	16.43	20.11
	R2	24.23	19.43	16.43	20.03
	R3	24.30	19.57	16.20	20.02
	Mean	24.34	19.47	16.36	
Crude fibre (%)	R1	0.94	0.90	0.88	0.91
	R2	0.92	0.89	0.87	0.90
	R3	0.93	0.88	0.87	0.90
	Mean	0.93	0.89	0.87	
Ash (%)	R1	1.13	1.05	0.95	1.04
	R2	1.17	1.05	0.94	1.05
	R3	1.16	1.04	0.96	1.05
	Mean	1.15	1.05	0.95	

R1 = Control (Storage of kernels for 30 days in 15% salt solution without blanching +TSS 80%)
R2 = Treatment (Storage of kernels for 30 days in 15% salt solution followed by blanching for 2 min + TSS 70%)
R3 = Treatment (Storage of kernels for 30 days in 15% salt solution followed by blanching for 2 min +TSS 80%)

Chemical analysis of mango seed kernel chutney
Chemical analysis of mango seed kernels chutney showed in Table 2.

Effect on Total Soluble Solid (TSS ^{0}B)
It was found that R2 has maximum TSS, followed by R3 while, R1 has minimum TSS content. The experiment showed that the TSS content varied with the storage interval. R1 contain 50.17^{0}B, R2 contain 50.27^{0}B while R3 contain 50.22^{0}B. TSS of mango seed kernels chutney was increased from 50.07 to 50.37 ^{0}B during storage interval might due to loss in moisture content. Similar results were reported by Singhania *et al.* (2020) [17] in wood apple chutney and Thakur *et al.* (2017) [20] in wild pomegranate chutney.

Effect on pH
The maximum pH was recorded in recipe R3 while minimum pH was observed in recipe R2 of mango seed kernel chutney. Data showed that R1 contain 4.38, R2 contain 4.37 while R3 contain 4.39 pH value. The decrease in pH might due to change in titrable acidity. Similar result was reported by Singhania *et al.* (2020) [17] in wood apple chutney and Husaini *et al.* (2019) [18] in mango chutney.

Effect on Titrable acidity (%)
The experimental data showed that R3 has maximum while R1 has minimum titrable acidity. R1 contain 1.59%, R2 contain while R3 contain 1.61%. Slight variation in acidity during storage might be due to the formation of organic acid by ascorbic acid degradation (Thakur *et al.*, 2018) [19]. Similar result have been reported by Singhania *et al.* (2020) [17] and Veerapandian *et al.* (2014) [21] in peanut chutney and wood apple chutney, respectively.

Effect on Ascorbic acid (mg/100g)
Significantly higher ascorbic acid (was recorded in recipe R1 and lower ascorbic acid was found in recipe R3 of mango seed kernels chutney. It is found that R1 contain 3.36 mg/100g, R2 contain 3.34 mg/100g and R3 contain 3.28 mg/100g ascorbic acid. The decrease in ascorbic acid during storage might be due to degradation of L-ascorbic acid into dehydroascorbic acid (Thakur *et al.*, 2018) [19]. Similar results have been recorded by Singhania *et al.* (2020) [17] they observed that the ascorbic acid decrease in wood apple chutney on storage. Similar results have been recorded by Thakur *et al.* (2017) [20] and Bhardwaj *et al.* (2016), in wild pomegranate chutney and guava jamun chutney, respectively.

Effect on Total sugars (%)
Total sugars was found maximum in R3 while minimum in R1. Total sugars in R1 (40.46%), R2 (40.49%) and R3 (40.89%). The increase sugars during storage might be due to hydrolysis of polysaccharides starch into simple sugars (Thakur *et al.*, 2018) [19]. Similar result have been found by Bhardwaj *et al.* (2016) [5] in guava jamun chutney during storage.

Effect on Reducing sugars (%)
The maximum reducing sugar content was recorded in chutney prepared from recipe R1. R1 contain 25.83% reducing sugars while R2 and R3 contain 25.70% reducing sugars in chutney Increase in reducing sugars was observed during storage period might be due to hydrolysis of polysaccharides into simple sugars (Thakur *et al.*, 2018) [19]. The interaction between recipe and storage intervals was found to be non-significant. Similar result have been recorded by Synrem (2013) [18] and Kumar and Ray (2008) [10] in bamboo chutney and mushroom chutney during storage

Table 3.3: Changes in TSS ^{0}B, pH, titrable acidity (%), ascorbic acid (mg/100g), total sugars (%) and reducing sugars (%) of mango seed kernels chutney during storage at ambient temperature

Parameters	Recipe	Storage Intervals			Mean
		0 Days	45 Days	90 Days	
TSS (^{0}B)	R1	50.07	50.16	50.27	50.17
	R2	50.07	50.27	50.47	50.27
	R3	50.07	50.23	50.36	50.22
	Mean	50.07	50.22	50.37	
pH	R1	4.50	4.41	4.22	4.38
	R2	4.49	4.37	4.26	4.37
	R3	4.50	4.39	4.29	4.39
	Mean	4.50	4.39	4.26	
Titrable Acidity (%)	R1	1.45	1.62	1.70	1.59
	R2	1.49	1.63	1.69	1.60
	R3	1.51	1.61	1.71	1.61
	Mean	1.48	1.62	1.70	

Ascorbic acid (mg/100g)	R1	4.17	3.57	2.34	3.36
	R2	4.10	3.56	2.35	3.34
	R3	3.97	3.57	2.32	3.28
	Mean	4.08	3.57	2.33	
Total sugars (%)	R1	44.83	41.47	35.07	40.46
	R2	44.50	41.77	35.20	40.49
	R3	44.83	42.47	35.37	40.89
	Mean	44.72	41.90	35.21	
Reducing sugars (%)	R1	25.37	25.97	26.17	25.83
	R2	25.13	25.90	26.07	25.70
	R3	25.37	25.70	26.03	25.70
	Mean	25.29	25.86	26.09	

R1 = Control (Storage of kernels for 30 days in 15% salt solution without blanching +TSS 80%)
R2 = Treatment (Storage of kernels for 30 days in 15% salt solution followed by blanching for 2 min + TSS 70%)
R3 = Treatment (Storage of kernels for 30 days in 15% salt solution followed by blanching for 2 min +TSS 80%)

Conclusion

The present investigation revealed that mango seed kernels possess the better nutritional value and can be very well utilized for the preparation of chutney by using different recipe and safely preserved up to a period of 90 days under ambient conditions with minimal changes in chemical, sensory and microbial attributes.

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