

Research Article

Influence of Various Sucrose Concentrations on the Quality of Prepared Plum Chutney During Storage

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The research was evaluated the processing method of chutney to get the diverse uses of the plum with five treatments. The prepared chutney was stored for six months in glass container. The pH was increased slightly where the acidity was decreased. The intensity of the light-yellow color of the chutney was gradually increased and turned light red in color in storage. No microbial growth of the plum chutney was observed for any treatment up to five, but an acceptable non-pathogenic germ count was identified in various treated chutneys after six months. The relative sensory assessment of the plum chutney is evaluated and resulted in the maximum overall acceptance of 8.5 for treatments T3 (40% sucrose in plum) followed by treatments T2 with a rating of 7.5. The results showed that considering various quality parameters of the chutney; the best recipe was to use plums with 40% sucrose.

Keywords: Plum chutney, Acidity, Color, Microbial count, Overall acceptability.

INTRODUCTION

Plum (*Prunus domestica*) can use as fresh fruit for dessert, dehydrated or fit for human consumption. Plum juice is extensively researched as a flavoring in the food factory (Doymaz, 2006). But it has an astringent taste, hasn't been widely used, and has yet to be used for its use in processing. BARI Alu bukhara-1 is the new plum variety brought out by the Spice Research Center of the Bangladesh Agricultural Research Institute (BARI), which offers more yield and is beneficial to the farmers (Anonymous, 2014). The plum fruits are spoiled or misused by farmers or breeders in Bangladesh due to a lack of processing practices. As far as plum chutney is concerned in Bangladesh, as we know, is an insufficient producing country and almost unavailable in the local market. Therefore, making plum chutney from plum fruits is one of the new ideas for long-term consumption and is used in the off-season.

The plum fruits are naturally perishable and only available for a period of time from June to July. In some cases, the ripened plums are eaten fresh. Some value-added products like jam, jelly, pickle, chutney, sauce, etc. could be made from surplus plums. Chutney is a term used for a wide variety of spicy dishes and condiments in Indian cuisine, its increasing popularity reflecting the inclusion of ethnic cuisines in the Western diet.

It is essentially an Indian preparation that goes well with the main course as a side dish, which can be prepared with spices, vegetables, fruits and herbs.

Using oil, vinegar, or fermenting citrus juice with salt can be used to preserve cooked chutney. For the natural preservation process, acetic acid is used in vinegar. Nowadays it is also very popular in western cuisine Chutneys are thick, jam-like mixes made from a variety of fruits and vegetables. More recently, chutney making in India has been migrated to commercial production, while previously it was done entirely in people's homes. The disadvantage of commercial chutneys and those made the western style with vinegar and large amounts of sugar is that the main goal of sugar and vinegar as preservatives is to make the product safe for long-term consumption. Chutneys are mostly made from raw materials that indicate they should be consumed immediately or kept at room temperature for later use.

Due to the lack of transport, preservation and marketing possibilities, plums, in particular, are injured, stained and exhausted, especially in the high growth period. Preparing plum chutney can be the most representative and appropriate approach to plum processing. Chutney is a pleasant product made primarily from fruits and vegetables that go well with Indian and continental

dishes.

Chutneys of various types are prepared in Bangladeshi households and also on a commercial scale. In the first case, standard recipes were modified by local tastes. Fruits such as apples, peaches, plums, apricots and mangoes as well as vegetables such as beets, cauliflower, carrots, etc. are the basic raw materials for these products. Onion, garlic, spices, herbs, etc. are added for flavor. Vinegar, table salt, and sugar are also used to make them more palatable. Vinegar serves as a preservative to some extent. Taking consideration of several technological aspects, the current research was therefore deliberately designed with the aim of standardizing a suitable combination of plum and sucrose for the production of plum chutney and evaluating the nutritional quality of the stored

chutney on the basis of new plum varieties used in Bangladesh.

MATERIALS AND METHOD

Collection of Fresh Plum

Plum (*Prunus domestica*) with optimal ripeness and firm texture was collected by BARI's Spice Research Center and a local farmer. The plums were transported in plastic boxes to the laboratory of BARI's Postharvest Technology Division, Gazipur. After sorting, the plum was washed and dried under a ceiling fan.

Table 1. The following ingredients were used to prepare the plum chutney.

Item	Quantity
Plum	1.0kg
Sugar	Recommended dose
Salt	32.0g
Salt (bit labon)	5.0g
Red chilli powder	6.0g
Fenugreek powder	5.0g
Mustard powder	12.0g
Cumin powder	2.5g
Kawlanji	8.0g
Black pepper powder	1.0g
Cloves powder	0.5g
Cinnamon powder	1.0g
Joyfal	1.0g
Joytri	0.5g
Mustard oil	100ml
Acetic acid	6.0 ml
Sodium benzoate	0.75g

Preparation of Plum Chutney

To prepare the chutney, the dried spices such as black pepper, cumin, kawlanji, cinnamon, red chili, clove and cardamom were ground into powder. Select, sort and wash fully ripe plums. After washing, cook the plum until it becomes soft. Remove the pan from the burner and after cooling, separate the pulp by squeezing with the hand. Then add the required amount of sugar and heat. Add oil, salt and dry spice powder one after the other and continue heating. When the mixture is concentrated, add acetic acid and cook until the Brix gets to 620, and then add sodium benzoate. Remove the pan from the burner and transfer the prepared chutney to a sterile glass bottle. All packaged

products were properly labeled and stored at ambient temperature (25-30°C). The physicochemical and sensory properties of all

products were analyzed at intervals of one month after storage for 6 months. There were four treatments: T1 = Using 20% sucrose in plum; T2 = Using 30% sucrose in plum; T3 = Using 40% sucrose in plum; T4 = Using 50% sucrose in plum; and T5 = Using 60% sucrose in plum

The following flowchart shows the plum chutney preparation process as shown in Figure 1:

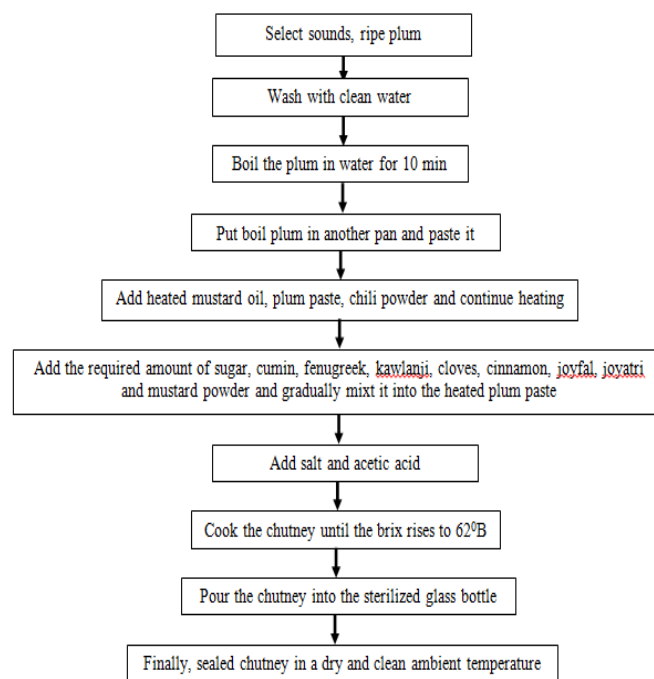


Figure 1. Step of the flow chart for the plum chutney preparation

Measurement of pH

Using a glass electrode manufactured by EUTECH Instruments, Selangor, Malaysia, the pH was calculated for the chutney sample of 5 g which was diluted with 45 ml of distilled water.

Measurement of Titratable Acidity

The titration method was used to analyze the Titratable Acidity (TA) of plum chutney. The treated chutney sample amount of 10 g was adjusted with 40 ml of distilled water with a mixture and then filtered through cotton wool. The 5 ml of filtrate used as an indicator with a drop of 0.1% phenolphthalein was titrated with 0.1 N NaOH to a pH of 8.1, which was the endpoint for the pink color. The calculated acidity of the prepared chutney was given as percent citric acid per 100 g fresh weight.

Product Appearance/Color

A tristimulus colorimeter (CR-400, Minolta Corp., Japan) was used to determine the color of plum chutney. 100 typical observers were used for the relevance method, where L (brightness), a * (-green to + red) and b * (-blue to + yellow) are the color coordinates. The specific details of the measurement procedure were previously discussed by Pervin et al. (2021).

Microbial Count

The microbial load of the plum chutney was determined using plate count agar. The microbial load count was carried out at every monthly interval up to 6 months of storage. During the counting

Measurement of the pH of stored plum chutney

The effects of sucrose on the pH of stored chutney during storage are

process, a 10g chutney sample was homogenized with 90 ml peptone-water buffer solution and then 10L suspension inoculated into the Plate Counting Agar (PCA) medium by 10-fold serial dilution. Then the inoculated plate was incubated at 37°C. For 24 hours in an incubator (model: SHC-4A1). Various colonies of bacteria grown in this medium were counted. The following formula was used for the number of colonies in cfu/g:

Organoleptic Test

The organoleptic examination of the plum chutney was carried out for each month of up to 6 months using a questionnaire that was evaluated by taste experts. The individual treatment was assigned as a letter code in order to eliminate prejudice between the panelists. The treated samples were offered to the panelists in various orders to get off preferring the sequence between the taste panels. The plum chutney was evaluated by 10 skilled members who were requested to rate the treated chutney based on plum color, bad odor, inflexibility, equilibrium of sweet-sour, as well as overall acceptability using a 9-point hedonic ruler.

Analysis of the Experimental Data

All treatments were repeated thrice and the research was done using a Completely Randomized Design (CRD). Using statistical software from R, collected data were analyzed for ANOVA to equate the means and level of significance of the data.

RESULTS AND DISCUSSION

The plum chutney was stored at ambient conditions for six months. The changes in various physicochemical parameters of the plum chutney are shown in Table 1 to Table 5. depicted in Table 1.

Table 2. Effect of sucrose on the pH content of plum chutney during storage.

Treatments	pH content of the plum chutney with different storage times (months)						
	0	1	2	3	4	5	6
T ₁ =20% sucrose	2.59	2.69	2.7	2.74	2.76	2.78	2.81
T ₂ =30% sucrose	2.63	2.71	2.73	2.76	2.77	2.79	2.83
T ₃ =40% sucrose	2.67	2.74	2.75	2.77	2.79	2.8	2.85
T ₄ =50% sucrose	2.71	2.75	2.76	2.79	2.81	2.83	2.88
T ₅ =60% sucrose	2.73	2.76	2.78	2.81	2.83	2.85	2.91
CV (%)	0.75	0.613	0.54	0.665	0.57	0.693	0.519
LSD _{0.1%}	0.036	-	-	-	-	-	0.027
LSD _{1.0%}	-	0.03	0.027	0.034	0.029	0.035	-

Initially, the maximum pH of 2.73 was observed with treatment T₅ and the pH of 2.59 was lowest with treatment T₁. However, the pH was increased in stored chutney for a storage period of 6 months. The initial pH of the plum chutney was lower than that of the final product and analogous outcomes were stated by Bhuiyan in hog plum. The increased concentration of sucrose can raise the pH of

plum chutney due to the increase in the lactic acid fermentation process; similar results were obtained in bottle carrots by Bansett. The increase in pH with increasing storage time could be due to lactobacilli, while the fastest growth of bacteria occurs under acidic conditions; this study was similar to Srivastva; Rekha; Pundir and Jain; Stella and Felix.

Table 3. Effect of sucrose on the acidity (%) of plum chutney during storage.

Treatments	Acidity (%) of the plum chutney with different storage times (months)						
	0	1	2	3	4	5	6
T ₁ =20% sucrose	1.79c	1.58c	1.52c	1.45c	1.41d	0.93e	0.85e
T ₂ =30% sucrose	1.82bc	1.66c	1.59c	1.51c	1.47c	1.23d	1.21d
T ₃ =40% sucrose	1.92b	1.81b	1.78b	1.75b	1.62b	1.52c	1.42c
T ₄ =50% sucrose	2.05a	1.90ab	1.86ab	1.81ab	1.74a	1.65b	1.57b
T ₅ =60% sucrose	2.10a	1.91a	1.87a	1.83a	1.76a	1.71a	1.65a
CV (%)	3.638	2.866	2.481	2.159	1.957	2.334	2.732
LSD _{0.1%}	0.128	0.092	0.078	0.066	0.057	0.06	0.067

Measurement of acidity of stored plum chutney Table 2 shows the effect of sucrose on acidity (%) of stored plum chutney during storage. During preparation, the initial acidity measurement was higher for treatment T₅ and lower for treatment T₁. However, the acidity decreased significantly month by month during storage and the lowest values were 0.85 in the T₁ treatment after 6 months. This could be attributed to the hydrolysis of polysaccharides and non-reducing sugars, using acid to convert them to hexose (reducing) sugars, and analogous explanations have been given by Thakur (2017) for wild pomegranate chutney. This could be explained by the differences in the physicochemical composition during different treatments and by the changes in the physicochemical composition of

the products during storage. The results are similar to those of Chaudhary and Verma in the aonla chutney. Statistically, there was a significant month-to-month decrease in average acidity. The acid in the processed products is lost through oxidation and the direct influence of ambient storage temperatures.

Measurement of the appearance/color of stored plum chutney, Color is a significant feature when observing plum chutney. Chutney color changes were monitored by estimating color coordinates (a* and b*) and lightness (L) during storage under ambient conditions using various percentages of sucrose used in plum chutney.

Table 4. Effect of sucrose on the color parameters of plum chutney in storage.

Treatment	Color parameters of the plum chutney with different storage times (months)						
	0	1	2	3	4	5	6
Lightness (L)							
T ₁ =20% sucrose	22.64a	24.27a	28.95a	33.64a	36.01a	47.10a	56.13a
T ₂ =30% sucrose	22.12a	22.89b	27.50b	32.11b	35.73ab	44.82b	49.46b
T ₃ =40% sucrose	20.83b	21.90c	26.91b	31.91b	35.19b	37.96c	40.51c
T ₄ =50% sucrose	20.12bc	21.03d	24.04c	27.04c	32.29c	32.07d	37.07d
T ₅ =60% sucrose	19.64c	20.68d	23.49c	26.29c	30.13d	31.66d	36.04d
CV (%)	1.985	1.874	1.791	1.42	1.277	1.263	1.393
LSD _{0.1%}	0.761	0.755	0.853	0.78	0.787	0.889	1.111
Coordinates (a*)							
T ₁ =20% sucrose	11.79a	12.69a	12.94a	13.19a	13.66a	13.71a	13.78a
T ₂ =30% sucrose	11.08b	11.41b	11.58b	11.74b	11.89b	11.98b	12.04b
T ₃ =40% sucrose	10.12c	10.24c	10.65c	11.05c	11.77b	11.87b	11.97b
T ₄ =50% sucrose	8.26d	8.56d	8.87d	9.17d	9.37c	10.17c	10.87c
T ₅ =60% sucrose	7.78e	7.83e	8.07e	8.31e	8.78d	9.17d	9.87d
CV (%)	1.719	1.744	1.821	1.966	2.073	2.195	2.244
LSD _{0.1%}	0.307	0.322	0.345	0.382	0.418	0.454	0.478
Coordinates (b*)							
T ₁ =20% sucrose	13.41a	15.31a	16.89a	18.47a	28.77a	33.55a	34.87a
T ₂ =30% sucrose	11.11b	12.28b	14.76b	17.24b	18.35b	22.58b	28.24b
T ₃ =40% sucrose	8.78c	12.07b	12.41c	12.75c	14.16c	19.46c	29.77c
T ₄ =50% sucrose	7.05d	9.47c	10.71d	11.95d	13.05d	15.32d	27.53d
T ₅ =60% sucrose	6.11e	8.32d	9.73e	11.14e	12.12e	13.84e	26.91e
CV (%)	2.131	1.883	1.783	1.74	1.563	1.383	1.06
LSD _{0.1%}	0.36	0.394	0.418	0.453	0.492	0.527	0.568

The values are shown in Table 3 and show that the intensity of the light-yellow color of the chutney has gradually increased and changes to a light red color during storage after six months. The highest

brightness was observed with treatment T₁ and the lowest with treatment T₅, but the lightness values were increased up to 6 months of storage. It was found that the lightness decreases as the percentage

of sucrose in the product increases. The a* value of the color coordinates indicates that the initial color of the plum chutney was light red, then it gradually increases up to 6 months of storage. On other hand, the color coordinates b* showed that the product color

was light yellow and finally turned yellow up to 6 months of storage. A lower percentage of sucrose in the product was responsible for the yellow color and a higher percentage of sucrose provided the light-yellow color of the product. A significant decrease in the color of the chutney was observed during prolonged storage. It can occur through changes in the action of chemical components or special enzymatic and non-enzymatic effects, including the degradation of anthocyanin pigments in the products. The present results as a tendency towards a decrease in color intensity agree with those of Chauhan in wild pomegranate chutney; and Sahni in amla chutney. Microbial count of stored plum chutney.

Table 5. Effect of sucrose on microbial growth of plum chutney in storage.

Treatments	Microbial count of the plum chutney with different storage times (months)						
	0	1	2	3	4	5	6
T ₁ =20% sucrose	ND	ND	ND	ND	ND	ND	23*10 ⁻⁸
T ₂ =30% sucrose	ND	ND	ND	ND	ND	ND	14*10 ⁻⁵
T ₃ =40% sucrose	ND	ND	ND	ND	ND	ND	3*10 ⁻⁵
T ₄ =50% sucrose	ND	ND	ND	ND	ND	ND	13*10 ⁻⁶
T ₅ =60% sucrose	ND	ND	ND	ND	ND	ND	4*10 ⁻⁷

Table 4 shows the effects of the sucrose percentage on the germ count of plum chutney during storage. Due to the higher dilution used for the enumeration, no microorganism was initially detectable. The microbial growth of the plum chutney from various treatments was not observed for up to five months of storage. However, the microbial growth of the plum chutney was observed in small numbers; these were non-pathogenic bacteria and an acceptable limit for human consumption for various treatments after six months. The fluctuations

may be due to fermentation in the presence of fungi, as Frazier and Westheff (1978) describe that fungi are the main spoilage organisms for fruit products. The shelf life of plum chutney was lower than that of the pickle, as described by Gupta, 1992 and. Organoleptic test of plum chutney The organoleptic properties of the plum chutney with different sucrose combinations are assessed during monthly storage. A relative sensory assessment of various quality features of the plum chutney for giving to the judgment of the 10-expert jury in Table 5.

Table 6. Effect of sucrose on overall acceptance of plum chutney in storage.

Treatments	Overall acceptance of plum chutney with different storage times (months)						
	0	1	2	3	4	5	6
T ₁ =20% sucrose	4.5c	4.0c	4.0d	4.0e	4.0e	3.5e	3.5e
T ₂ =30% sucrose	7.0a	6.5b	7.0b	7.0b	7.5b	7.5b	7.5b
T ₃ =40% sucrose	7.5a	8.0a	8.0a	8.0a	8.5a	8.5a	8.5a
T ₄ =50% sucrose	5.5b	6.0b	6.0c	6.0c	6.5c	6.5c	6.5c
T ₅ =60% sucrose	5.0bc	4.5c	4.5d	4.5d	4.5d	4.0d	4.0d
CV (%)	5.57	7.355	4.853	3.651	3.748	3.939	3.844
LSD _{0.1%}	0.598	0.776	0.521	0.399	0.423	0.423	0.399

This has an impact on its evaluation for the acceptance of the product. As shown in Table 5, among the treatments, the panelists gave the highest overall rating of chutney made with 40% sucrose (treatment T3) followed by 30% sucrose (treatment T2). In terms of overall acceptance, it was found that treatment T3 had the highest overall acceptance of 8.5 (i.e. like very much to like extremely), followed by treatment T2 with an overall acceptance of 7.5 (i.e. like moderately to like very much).

Panelists liked this plum chutney for its balance of optimal sucrose content, less bitterness, attractive color, and overall flavor as noted in the recorded datasheet. A significant decrease in overall acceptance was observed for stored plum chutney; this result is consistent with strawberry jam and was reported by Khan. For most treatments, the organoleptic rating of the plum chutney persisted up to an acceptable limit at the end of the storage period. The decrease in sensory values

during storage was also shown for ready-to-eat peanut chutney by Veerapandian and Ullah. for jam made from carrots and apples.

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