Physicochemical and organoleptic characterization of flavoured pineapple candy (*Ananas comosus* L.)

ABSTRACT

An experiment was conducted at the Post Harvest Technology, Department of Horticulture, SHUATS, Prayagraj (Uttar Pradesh) during the year 2022-2023. The pineapple (*Ananas comosus* L.) is a popular tropical fruit in India. It is well-known for its nutritional and therapeutic properties, but it is not an easy food to consume on its own. It has a lot of potential in processed forms like candy. Attempts are being made to create products that are not only nutritionally delicious but also consumer-acceptable. The medicinal, nutritional, and organoleptic quality of pineapple candy can be improved by mixing in different syrups such as mint syrup, rose syrup, tulsi syrup, ginger syrup, and cardamom syrup. The study followed a completely randomised design with three replications. The pineapple candy samples were examined for physicochemical changes after preparation and sensory evaluation was performed on a panel of 7 experts using a 9-point hedonic scale. These candies were kept at room temperature for around 90 days. The storage experiments demonstrated that total soluble solids and pH gradually increase till the end of the experiment, whereas titratable acidity and ascorbic acid decrease in decreasing order. Based on the organoleptic test results, treatment T3 (Pineapple + Sugar syrup @ 60% + Rose extract @ 10%) was determined to be the best-flavoured pineapple candy.

Key words: - Pineapple, candy, citric acid and syrup.

1. INTRODUCTION

Pineapple (*Ananas comosus* L.) is an important tropical fruit grown in India. Mild tropical climate is best suited for its cultivation. Kew, Mauritius and Queen are the commercially cultivated pineapple varieties. It is mainly propagated through slips, suckers and crown. Suitable months for planting is July- September. Fruits are ready for harvesting 18-24 months after planting. Application of ethylene is done in many commercial plantations for uniform ripening of fruits. The maturity indices include flattening of cones, increase in size and

change in colour of fruits starting from the base. An average yield of 50t/ha can be obtained from commercial farms. “The cultivation of Pineapple in India is mainly done in high rainfall and humid coastal regions in the peninsular India and hilly areas of north-eastern regions of the country. India is the 5th leading producer of pineapple in the world. Other leading producers include Thailand, Philippines, Brazil, China, Nigeria, Mexico, Indonesia, Colombia and USA” [1].

Pineapple has lately gained important elevation for its health promoting properties. Pineapple substantially contains sugar, protein, digesting enzyme bromelain, citric acid, malic acid, vitamin A, B, carotene and stimulating sugar- acid balance and is a veritably rich source of vitamin C and organic acids [2]. Pineapple is known for its nutritional and medicinal values. Eating pineapples may help in treating Cold and cough, strengthen bones and teeth, prevents cancer, reduce symptoms of arthritis, prevents hypertension, reduces threat of blood clots, etc. Pineapple is not an easy to eat out of hand item [3]. “The fruit has got great eventuality in processed forms, such as candy, preserve (murabba), sauce, pickles, jam, jelly, powder, squash, etc. Candy is one of the most popular pineapple products. A fruit, when impregnated with sugar, drained and dried, is called candy. It is tender, plump and exceedingly sweet with a strong flavour and without sticking. Pineapple candy can be bettered by the addition of different syrups in the pineapple candy like mint syrup, rose syrup, tulsi syrup, ginger syrup and cardamom syrup. Peppermint (*Mentha piperita* L.) is a prominent medicinal condiment and largely conceded by medicinal and food processing industries due to its excellent health benefits**.** Rose (*Rosa spp*.) is an important flower crop belonging to the family of Rosaceae. The flower is a good source of Vitamin C, carotenoids, phenolic components, minerals, and essential oil. The flavour of rose and its medicinal properties has a positive effect on any flavoured processed product. Tulsi (*Ocimum sanctum*) is also known as Holy Basil or Tulasi in Sanskrit. The plants extracts are generally used to treat a variety of conditions, including the common cold, intestinal illness, irritation, coronary illness, migraines, stomach troubles, kidney stones, heart issues, and malaria treatment. Ginger (*Zingiber officinalis* L.) is a member of the Zingiberaceae family. Ginger's unique aroma and medicinal rates are due to the presence of gingerol and oleoresin (a blend of volatile oil and resin). Gingerol components have remedial benefits for the treatment of poor digestion, heartburn vomiting, and precluding stir sickness”. [12] Cardamom extract also have significant antibacterial activity and is also veritably useful in the discovery of new antibiotics.

2. MATERIALS AND METHODS

2.1 Raw Material

Mature pineapples (of Kew variety) were purchased from a local fruit market at Mahewa, Prayagraj. Other ingredients like sugar, mint, rose, tulsi, ginger, cardamom and citric acid were brought from local shops in Prayagraj.

2.2 Procedure for making syrups from extracts

Sugar syrup: Sugar syrup is prepared by dissolving 600g of sugar in 1 litre of water and heating it to its boiling point.

Mint syrup: Mint leaves are cleaned and ground with a mortar and pestle. The ground mint leaves are then added to the water and cooked until it reaches the $3^{rd}/4^{th}$ stage. The extract is then strained through muslin fabric. The syrup is prepared by using the strained mint extract (10%), sugar syrup (60%) and citric acid (0.5g).

Rose syrup: Clean rose petals are soaked overnight in lukewarm water, then well rubbed, heated for about 5 minutes and strained by using sieve. The syrup is prepared by using the strained rose extract (10%), sugar syrup (60%) and citric acid (0.5g).

Tulsi syrup: Tulsi leaves are cleaned and ground with a mortar and pestle. The ground tulsi leaves are then added to the water and boiled until it reaches the 3^{rd} /4^{th} stage. The extract is then strained through muslin fabric. The syrup is prepared by using the strained tulsi extract (10%), sugar syrup (60%) and citric acid (0.5g).

Ginger syrup: Clean peeled gingers are ground and strained using muslin cloth. The syrup is prepared by using the strained ginger extract (10%), sugar syrup (60%) and citric acid (0.5g).

Cardamom syrup: Cardamoms are ground and boiled for about 4-5 minutes and strained using sieve/muslin cloth. The syrup is prepared by using cardamom extract (10%), sugar syrup (60%) and citric acid (0.5g).

2.3 Preparation of Pineapple Candy

Pineapple candy was prepared with different syrup solution i.e., Sugar syrup, Mint syrup, Rose syrup, Tulsi syrup, Ginger syrup and Cardamom syrup.

The sliced pineapple fruits were pricked with fork and soaked in 2 % salt solution (24 hrs). After washing the soaked pineapple slices in clean tap water were, blanched for about 4-5 minutes.

The blanched pineapple slices were steeped into the different syrup. After the completion of steeping time, the syrup was drained and pineapple slice were spread on the trays. Then pineapple slices laid in the trays were kept for drying in the dehydrator for 24 hours at 100°C.

After drying, the samples of the dehydrated pineapple candies were collected and packed in LDPE bags for storage purposes. Candies were stored at room temperature for 3 months for storage studies.

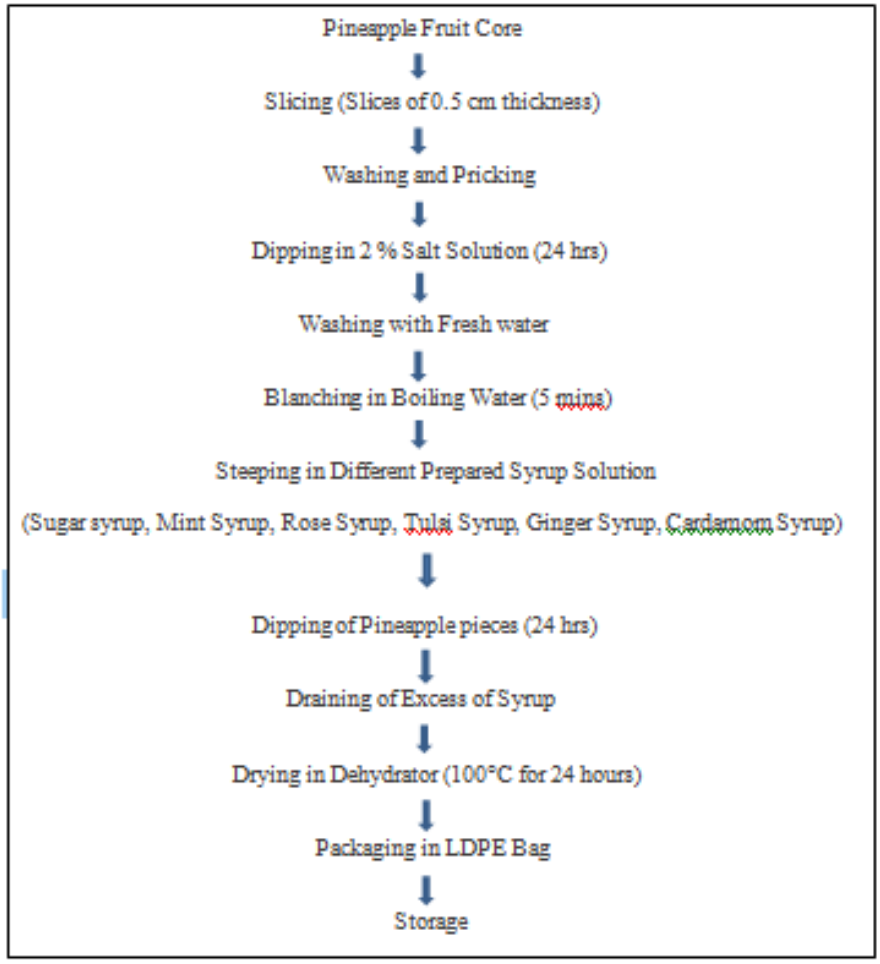

Chart 1: Flowchart of Pineapple Candy preparation.

2.4 Treatment Details

T1- Pineapple + Sugar syrup (60%)

T2- Pineapple + Sugar syrup (60%) + Mint extract (10%)

T3- Pineapple + Sugar syrup (60%) + Rose extract (10%)

T4- Pineapple + Sugar syrup (60%) + Tulsi extract (10%)

T5- Pineapple + Sugar syrup (60%) + Ginger extract (10%)

T6- Pineapple + Sugar syrup (60%) + Cardamom extract (10%)

2.5 Physico-chemical analysis and evaluation of organoleptic quality of pineapple candy

2.5.1 Titratable acidity (%)

"Titratable acidity was determined by titrating. 10ml of the homogenized sample was taken and made up to 100 ml volume in a volumetric flask. The contents were filtered through Whatman No. 1 filter paper. Titration against 0.1N NaOH was performed with a 10 ml aliquot using phenolphthalein as an indicator. The turn of the aliquot to light pink colour which persists for 15 seconds was considered an endpoint. The titratable acidity was estimated in terms of percent citric acid analyzed as per the Ranganna" [4].

2.5.2 pH

The sample was soaked in distilled water till it softens and ground along with the little amount of distilled water. The pH was then measured using an electronic pH meter.

2.5.3 Total soluble solids (°Brix)

"The percentage of total soluble solids was determined using a hand refractometer (Erma, Japan) by placing a drop of the filtered juice on the prism of the refractometer and observing the coincidence of the sample's shadow with the reading on the scale and expressed as ^{o}Brix to standard procedure as described in Ranganna"[4].

2.5.4 Ascorbic acid

"Determination of ascorbic acid was done by the 2, 6 – dichlorophenol indophenols dye method as described by Ranganna" [5]. "A known amount of sample was blended with 3% metaphosphoric acid (HPO_3) to generate a final volume of 100 ml, which was then filtered. A known quantity of aliquot was titrated against 0.025 percent 2, 6 - dichlorophenol indophenols dye to a pink colour endpoint. The ascorbic acid content of the sample was calculated while accounting for the dye factor and expressed as mg of Ascorbic acid per 100g". [12]

2.5.5 Organoleptic evaluation

"To assess consumer preference, the sensory evaluation of the experimental sample was conducted at different intervals by a panel of 7-8 expert judges. Colour and appearance, taste, aroma, and overall acceptability of samples were evaluated. Organoleptic evaluation was carried out in four terms (0, 30, 60, 90 DAS).Samples were served on coded plates. The judges scored the quality characteristics of each sample on the nine-point hedonic rating scale described by Srilakshmi" [6].

2.5.6 Shelf life

Shelf life of pineapple candy was assessed until the product was edible without any odour change or any fungal infections at ambient conditions.

3. RESULTS AND DISCUSSION

3.1 Titratable Acidity

During the storage term (90 days) at ambient room temperature, a gradual decrease was reported in the titratable acidity of pineapple candy (Table 1). The maximum value (0.40) was observed in treatment T2 treatment T2 (Pineapple + Sugar syrup @ 60% + Mint extract @ 10%) and minimum 0.37 was recorded in treatment T3 (Pineapple + Sugar syrup @ 60% + Rose extract @ 10%). The decreasing trend observed in acidity of candy might be due to the different types of flavouring agents employed during processing of candy. This decreasing trend might also be due to the loss of ascorbic acid from the pineapple candy as reported by Kumar and Singh [7] in aonla products**.**

3.2 pH

The gradual increase in pH during the storage period (90 days) was reported from pineapple candy (Table 1). The maximum value (3.88) was observed in treatment T4 (Pineapple + Sugar syrup @ 60% + Tulsi extract @ 10%) and T5 (Pineapple + Sugar syrup @ 60% + Ginger extract @ 10%) and minimum pH value was observed in treatment T3 (Pineapple + Sugar syrup @ 60% + Rose extract @ 10%) with a value of 3.74. Variation in pH might be due to the changes in chemical properties of pineapple candy which are affected during storage conditions. This may also be due to the decreasing trend of Titratable acidity exhibited, which have increased the pH of pineapple candies during storage.

3.3 Total Soluble Solids (TSS)

Observed gradual increase in total soluble solids during the storage period (90 days) of pineapple candy (Table 1) might be due to the conversion of polysaccharides into sugars during the hydrolysis process. Similar observations of gradual increase in total soluble solid were reported by Ghanwat et al. [8] in aonla candy and Jain et al. [9] in osmotic dehydration of papaya cubes. The maximum value (66.33°Brix) was observed in treatment T3 (Pineapple + Sugar syrup @ 60% + Rose extract @ 10%) and minimum value (63.58°Brix) was observed in T2 (Pineapple + Sugar syrup @ 60 % + Mint extract @ 10 %).

3.4 Ascorbic Acid

Gradual reduction in ascorbic acid during the storage period (90 days) of pineapple candy was observed (Table 1). The loss of vitamin C in processed pineapple candy was mainly due to leaching in syrup as well as thermal dehydration. “It might also be due to oxidation by trapped oxygen in the packaging container, which results in the formation of dehydroascorbic acid. Similar observations of gradual decrease in ascorbic acid were reported by Kumar and Singh [7] in aonla products and Deepika et al. [10] in quality of enriched fruit bars during storage. The maximum value (4.93 mg/100g) was observed in treatment T3 (Pineapple + Sugar syrup @ 60% + Rose extract @ 10%) and the minimum ascorbic acid content (4.60 mg/100g) was recorded in treatment T6 (Pineapple + Sugar syrup @ 60% + Cardamom extract @ 10%)”.

3.5 Organoleptic Evaluation

By the organoleptic evaluation colour and appearance, taste, aroma, and overall acceptability carried out in four terms (0, 30, 60, 90 DAS) treatment T3 (Pineapple + Sugar syrup @ 60% + Rose extract @ 10%) obtained the highest sensory score of 6.68, 7.21, 7.08, and 6.99 (Table 2) in all parameters of organoleptic attributes, it indicated that it was well-received by the judges.

3.6 Shelf life of Pineapple Candy

From the shelf life point of view during the storage period (90 days), the highest was recorded in T3 (Pineapple + Sugar syrup @ 60% + Rose extract @ 10%) at 89.24 and lowest (87.56) in treatment T1 (Pineapple + Sugar syrup @ 60%) respectively. Similar observation was reported by Jothi et al. [11] on effect of storage time of the quality of the pineapple candy.

Table 1. Changes in acidity, pH, and TSS and Ascorbic acid of the pineapple candy during storage period

Treatments	Titratable Acidity (%)				pH				TSS (° Brix)				Ascorbic acid (mg/100g)			
	0 DAS	30 DAS	60 DAS	90 DAS	0 DAS	30 DAS	60 DAS	90 DAS	0 DAS	30 DAS	60 DAS	90 DAS	0 DAS	30 DAS	60 DAS	90 DAS
T1	0.45	0.43	0.41	0.39	3.65	3.71	3.80	3.83	64.67	65.29	65.38	65.55	5.25	5.21	4.94	4.79
T2	0.47	0.46	0.42	0.40	3.60	3.72	3.79	3.82	62.93	63.07	63.57	63.58	5.23	5.20	4.93	4.80
T3	0.41	0.41	0.40	0.37	3.54	3.69	3.71	3.74	64.00	64.33	65.35	66.33	5.25	5.20	5.10	4.93
T4	0.44	0.42	0.40	0.38	3.68	3.82	3.83	3.88	62.67	64.10	64.32	64.46	5.22	5.18	4.78	4.65
T5	0.46	0.45	0.41	0.39	3.65	3.72	3.78	3.88	62.83	63.63	64.15	64.50	5.26	5.21	5.08	4.89
T6	0.48	0.47	0.42	0.39	3.62	3.71	3.73	3.79	63.67	63.07	64.13	64.67	5.21	5.18	4.84	4.60
F-test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
S. Ed(±)	0.007	0.011	0.005	0.007	0.025	0.023	0.036	0.038	0.349	0.30	0.247	0.272	0.008	0.007	0.480	0.038
C. D. @ 5 %	0.016	0.023	0.016	0.016	0.056	0.05	0.079	0.083	0.769	0.662	0.545	0.599	0.017	0.015	0.106	0.084

Table 2. Changes in colour and appearance, Taste, Aroma, Overall acceptability and shelf life of the pineapple candy during storage period

Treatments	Colour and Appearance				Taste				Aroma				Overall Acceptability				Shelf life
	0 DAS	30 DAS	60 DAS	90 DAS	0 DAS	30 DAS	60 DAS	90 DAS	0 DAS	30 DAS	60 DAS	90 DAS	0 DAS	30 DAS	60 DAS	90 DAS	90 DAS
T1	5.41	5.10	4.60	3.89	5.58	5.48	5.15	4.92	5.77	5.67	5.49	5.30	5.59	5.42	5.08	4.70	87.56
T2	6.13	5.90	5.67	5.08	6.57	6.45	6.17	5.87	6.86	6.35	6.29	6.13	6.52	6.24	6.04	5.69	88.64
T3	7.75	7.62	6.88	6.68	7.98	7.92	7.59	7.21	8.12	7.91	7.34	7.08	7.95	7.82	7.27	6.99	89.24
T4	6.31	6.20	5.88	5.18	6.98	6.82	6.59	6.20	7.50	7.38	7.15	6.44	6.93	6.80	6.54	5.94	89.15
T5	5.98	5.59	5.09	4.89	6.25	6.10	5.79	5.49	6.97	6.59	6.19	5.54	6.40	6.09	5.69	5.30	88.82
T6	5.53	5.22	4.92	4.75	6.11	5.99	5.74	5.14	6.19	5.79	5.42	5.34	5.94	5.67	5.27	5.08	88.30
F-test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
S. Ed(±)	0.344	0.303	0.235	0.284	0.288	0.299	0.258	0.293	0.249	0.258	0.237	0.316	0.325	0.326	0.372	0.418	0.241
C. D. @ 5 %	0.758	0.668	0.519	0.625	0.635	0.658	0.569	0.646	0.549	0.568	0.521	0.697	0.716	0.717	0.819	0.921	0.531

Table 3. Economics of different treatments on benefit cost ratio of pineapple candy

Treatments	Treatment Combination	Total Cost of preparation (Rs.)	Pineapple Candy output (80g)	Selling Rate (Rs./Package)	Gross Return (Rs.)	Net Return (Rs.)	Benefit cost ratio
T1	Pineapple + Sugar Syrup (60%)	106.14	3	80	240	133.86	2.26
T2	Pineapple + Sugar Syrup (60%) +Mint extract (10%)	131.14	3	100	300	168.86	2.29
T3	Pineapple + Sugar syrup (60%) + Rose extract (10%)	146.14	3	120	360	213.86	2.46
T4	Pineapple + Sugar syrup (60%) + Tulsi extract (10%)	131.14	3	100	300	168.86	2.29
T5	Pineapple + Sugar syrup (60%) +Ginger extract (10%)	131.14	3	100	300	168.86	2.29
T6	Pineapple + Sugar syrup (60%) + Cardamom extract (10%)	131.14	3	95	285	153.86	2.17

4. CONCLUSION

In this investigation, the treatment T3 (Pineapple + Sugar syrup @ 60% + Rose extract @ 10 %) was the best treatment from point of view physico-chemical properties i.e., total soluble solids (66.33), titratable acidity (0.37), pH (3.74) and ascorbic acid content (4.93 mg/100g) and organoleptic properties i.e., colour and appearance (6.68), taste (7.21), aroma (7.08) and overall acceptability (6.99). As a result, one of the upcoming value added food products could be the produced Pineapple candies, which could have a healthy commercial market and be able to attract consumers of all ages. The maximum shelf life (89.24) was recorded in T3 (Pineapple + Sugar syrup @ 60% + Rose extract @ 10%). Similarly, the treatment T3 (Pineapple + Sugar syrup @ 60% + Rose extract @ 10%) showed the highest BC ratio (1:2.46). Thus, it is ultimately determined that the processing method created for making pineapple candy is technologically and economically viable and may therefore be used commercially.

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