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Preparation of value added herbal pineapple candy and analysis of physico-chemical and organoleptic attributes

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Abstract

Pineapple is a most economically significant tropical fruit, grows as a small shrub. It is also known as queen of fruits. It is indigenous to South America and it has exceptional juiciness and a vibrant tropical flavor that balances the tastes of sweet and tart. This fruit is highly perishable and seasonal, hence processing is necessary. Processed pineapple is popular and is exported by many countries. During processing, nutritional quality of pineapple can be affected but there are recent researches carried out which use new technologies to retain the nutritional quality of the pineapple fruit. This is to meet the consumer demand for healthy, nutritious, and natural products. So, to recommend the best quality of value added processed pineapple an experiment entitled "Preparation of value added herbal pineapple candy and storage study of physico-chemical and organoleptic attributes" was conducted at the Post Harvest Laboratory, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.) during the year 2022-23. It comprised of 6 treatments replicated thrice in a Completely Randomized Design. The main objective of the investigation was to determine the value added best quality herbal pineapple candy of different herbal treatment combinations such as Cardamom, Rose, Ginger, Basil leaves, Betel leaves & Lemon grass at the level of 10% each. From the present investigation the treatment with 10% of Basil leaves found best with TSS (73.75 °Brix), Total sugar (65.30%), Reducing sugar (57.70%), Acidity (0.10%), Ascorbic acid (6.10 mg/100 g pulp) after 90 days of storage.

Keywords: Pineapple candy, physico-chemical, organoleptic attribute, TSS, acidity, sugars, herbal flavours

Introduction

The Pineapple (*Ananas comosus* L.) is a tropical plant with edible juicy fibers and the most economically significant plant in the family bromeliaceae. It matures within 18-22 months after plantation (Wood, 1988) [13].

It is indigenous to South America. It has exceptional juiciness and a vibrant tropical flavor that balances the tastes of sweet and tart. The name pineapple in English (or piña in Spanish) comes from the similarity of the fruit to a pinecone. Ananas comes from anana, the Tupi word for the fruit, meaning "excellent fruit". Comosus means tufted and refers to the stem of the fruit (Sen, 1990) [12].

Pineapple is an important fruit showing an increasing demand worldwide, over the years. India is the 5th largest producer of pineapple with an annual output of about 1.2 MT in the world, its share in the world production is 8%. The different Asian countries and the countries around the Indian ocean is importing about two lakh tons of pineapple in an year, mostly coming from distant countries. This market can be exploited by Kerala if an earnest effort is made in the right direction. Area & production under pineapple cultivation is about 106,000 Ha and 1,808,000 MT in India respectively. Pineapple is a major fruit of Bangladesh. The major pineapple producing states in India are Assam, West Bengal, Karnataka, Meghalaya, Manipur, Arunachal Pradesh, Kerala and Bihar. India exports pineapple mainly to Nepal, Maldives, United Arab Emirates, Saudi Arabia, Kazakhstan, Oman, Bahrain, Bangladesh, Zambia, Pakistan and Qatar. 'Kew' and 'Mauritius' are the two varieties of pineapple grown in India. It is grown in Karnataka, Meghalaya, West Bengal, Kerala, Assam, Manipur, Tripura, Arunachal Pradesh, Mizoram, and Nagaland. It is also cultivated on limited areas in the coastal belt of Tamil Nadu, Goa and Odisha (NHB, 2022).

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The pineapple fruit is rich in vitamin C (47.8 mg) and Manganese, providing 131% and 76% of the daily recommendations respectively. Vitamin C is essential for growth and development, a healthy immune system and aiding the absorption of iron from diet. Meanwhile, manganese is a natural occurring mineral that aids growth, maintains a healthy metabolism, and has antioxidant properties.

Fruit contained enzyme, bromelain and leaf is a good source of chlorophyll. When taken with meals, bromelain aids in the digestion of proteins, working to break proteins down into amino acids. Pineapple contains 81.2% to 86.2% moisture, and 13-19% total solids, of which sucrose, glucose and fructose are the main components. Carbohydrates represent up to 85% of total solids whereas fiber makes up for 2-3%. Of the organic acids, citric acid is the most abundant in it. The pulp has very low ash content, nitrogenous compounds and lipids (0.1%). Fresh pineapple contains minerals as Calcium, Chlorine, Phosphorus and Sodium (Bose, 1990) [12].

There are different varieties of pineapples growing worldwide such as Smooth Cayenne, Hilo, St. Michael, Giant Kew, Charlotte Rothschild, Perolera, Bumanguesa, Monte lirio. Pineapples also have many potential health benefits. Eating pineapples may lower the risk of heart disease, cancer, and kidney stones, arthritis, blood clots, nausea. It also treats skin acne and acts as a natural energizer and stress buster.

Most of the fruits and vegetables, their availability is limited during off-seasons. Many techniques have been developed to make available seasonal fruits as well as vegetables even during off-season. The pineapple does not lend itself well to freezing, as it tends to develop off flavour and lose texture or crispiness. This fruit is highly perishable and seasonal, hence processing is necessary. Processed pineapple is popular and is exported by many countries. During processing, nutritional quality of pineapple can be affected but there are recent researches carried out which use new technologies to retain the nutritional quality of the pineapple fruit. This is to meet the consumer demand for healthy, nutritious, and natural products.

Dried pineapple for processing is used in many areas such as an ingredient in confectioneries, breads and desserts. Dried fruits are often eaten directly out of the container, with yogurt, or by adding them to homemade baked goods such as cookies. They are generally added in processed foods such as snacks including biscuits, cookies, chocolates, bread, yogurt, fruit jelly, breakfast cereal, health foods, or sauce for Japanese-style pancakes. Bakery products and breakfast cereal mixes are the largest end users of dried fruit. According to the Institute of Food Technologists, dried fruits and fruit chips are the hottest trends in the snack business (Bose, 1990) [12].

Sugar is used to preserve fruits, either in syrup with fruit such as apples, pears, peaches, apricots, plums or in crystallized form where the preserved material is cooked in sugar to the point of crystallization and the resultant product is then stored dry. Candy is a sweet food prepared from fruits or vegetables by impregnating them with sugar syrup followed by draining of excessive syrup and drying the product to a shelf stable state. Fruits and vegetables like apples, ginger, mangoes, guava, carrots, citrus, peels have been used to prepare candies (Mehta *et al.* 1995) [7]. Fruits, impregnated with sugar on glucose syrup and subsequently drained free of syrup and dried is known as candy. The most suitable fruits and vegetables for preserves and candy are pineapple, cherry, aonla etc.

Further, attributable to least commercial involvement, the pineapple is still to be used in processed industries. And also there are huge requirement for this type product from the stand point of health and nutrition.

Materials and Methods

“Preparation and storage study of pineapple candy” experiment was carried out in the post harvest lab, Department of Horticulture, Naini Agricultural Institute (NAI) SHUATS, Prayagraj, U.P. India.

The methods employed during the course of investigation and materials utilized have great significance in research programme. The details of the techniques employed in carrying out the investigation are described through the flow chart (fig.1). The fresh and fully matured pineapple (Queen Variety), sugar and salt collected from the local market were used in the experiment. Other ingredients were used from laboratory stocks. There are different equipments used during preparation of pineapple candy such as; weighing balance, induction sealer, fruit cutter, texture profile analyzer, incubator etc. Processing of pineapple candy is carried out through 6 treatment combinations with 3 replications of each. The candies are constituted treatment combinations *viz*, Cardamom, Betel leaves, basil leaves (Tulsi), Ginger, Roses and Lemon grass. Physicochemical attributes like TSS, Reducing sugar, Total sugar, Ascorbic acid, Acidity and Organoleptic evaluation includes color, texture, taste, flavour and overall acceptability were measured successfully up to 90 days after storage to indicate the best and recommended treatment combination of pineapple candy.

Table 1: Treatment Details

| Treatment | Treatment combinations |
|----------------|----------------------------------|
| T ₀ | Control |
| T ₁ | Sugar @ 70% + Basil leaves @ 10% |
| T ₂ | Sugar @ 70% + Betel leaves @ 10% |
| T ₃ | Sugar @ 70% + Cardamom @ 10% |
| T ₄ | Sugar @ 70% + Ginger @ 10% |
| T ₅ | Sugar @ 70% + Lemongrass @ 10% |
| T ₆ | Sugar @ 70% + Rose syrup @ 10% |

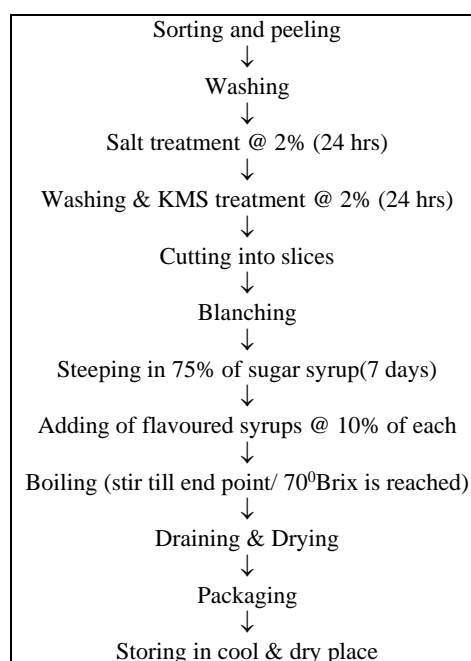


Fig 1: Flow chart of pineapple candy

Results and Discussion

Physico-chemical attributes

Pineapple candies were kept in storage for 3 months and observations were recorded at the interval of 30 days on various physico-chemical attributes such as TSS, Acidity, Ascorbic acid, Reducing sugar, and Total sugar. Data were analyzed statistically and results are presented below in the table 2 & 3.

TSS (Total Soluble Solid), Reducing sugar & Total sugar

After 90 days of storage, the data pertaining to TSS (Table 2.) of Pineapple candy, treatment T1; pineapple slices treated with 70% of sugar and 10% of Basil leaves recorded significantly the highest TSS (73.3°Brix) and treatment T6 recorded significantly the lowest TSS (70.3°Brix). The TSS increased with gradual passage of storage time, this might be due to conversion of polysaccharides into sugar during hydrolysis process during storage. Similar observations were reported by Awadhesh and Bhagwan (2017) [1] in mature fruits of wood apple. The results of reducing sugar and total sugar (Table 2) of the candy; treatment T1; pineapple slices treated with 70% of sugar and 10% of Basil leaves recorded significantly the maximum reducing sugar (73.30%). Treatment T0 (Control) recorded significantly the lowest reducing sugar (70.30%). The increase in reducing sugars indicates it could be due to moisture loss and inversion of non-reducing into reducing sugars by hydrolysis. Similar findings of Mhalaskar *et al.* (2012) [6] indicated the presence of 17.16% reducing sugars in fortified fig toffee. Observations of total sugar showed:

treatment T1; pineapple slices treated with 70% of sugar and 10% of Basil leaves recorded significantly the maximum Total sugars (65.30%). Treatment T0 (Control) recorded significantly the lowest Total sugars (50.70%). It has noticed that total sugar content gradually increased with storage period. Similar results were also reported by Manjunath (2014) [8] noticed that total sugars of guava leather increased with the increase of storage period.

Ascorbic acid and Acidity

After 90 days of storage, results of Ascorbic acid (Table 3) of the candy, revealed that effect of Treatment T1; pineapple slices treated with 70% of sugar and 10% of Basil leaves recorded significantly highest Ascorbic acid (6.10 mg/100 g pulp) and treatment T0 (Control) recorded significantly the lowest Ascorbic acid (4.60 mg/100 g pulp). There is a gradual decrease in ascorbic acid with storage time, this may be because of ascorbic acid is sensitive to heat and oxidized quickly in presence of oxygen. Similar results were also reported by Saini *et al.* (1995) [11] found that ascorbic acid content of wood apple decreased with sugar content and storage period. Regarding Acidity (Table 3) treatment T1; pineapple slices treated with 70% of sugar and 10% of Basil leaves recorded significantly lowest Acidity (0.1%) and treatment T0 (control) recorded significantly highest Acidity (0.3%). The decrease in acidity of pineapple candy with gradual passage of storage time might be due to the oxidation of acid during storage. Similar observations were reported by Babalola *et al.* (2002) [2].

Table 2: Effect of various treatments on TSS, Total Sugar & Reducing sugar of value added Pineapple candy (*Ananas comosus* L.)

| Treatment | TSS (°Brix) | | | | Total Sugar (%) | | | | Reducing Sugar (%) | | | |
|-----------|-------------|---------|---------|---------|-----------------|---------|---------|---------|--------------------|---------|---------|---------|
| | INITIAL | 30 days | 60 days | 90 days | INITIAL | 30 days | 60 days | 90 days | INITIAL | 30 days | 60 days | 90 days |
| T0 | 71.50 | 71.40 | 72.60 | 72.70 | 47.50 | 47.60 | 47.70 | 47.80 | 50.00 | 50.30 | 50.50 | 50.70 |
| T1 | 72.80 | 72.90 | 73.00 | 73.30 | 55.30 | 55.70 | 56.80 | 57.70 | 65.00 | 65.10 | 65.20 | 65.30 |
| T2 | 70.00 | 70.90 | 71.00 | 71.30 | 54.90 | 55.00 | 55.70 | 56.00 | 59.70 | 63.80 | 63.90 | 64.00 |
| T3 | 70.20 | 70.40 | 71.50 | 71.90 | 49.10 | 49.30 | 49.60 | 49.90 | 59.80 | 59.90 | 60.00 | 61.20 |
| T4 | 70.40 | 70.30 | 70.50 | 70.60 | 49.20 | 49.50 | 49.60 | 49.70 | 56.20 | 56.30 | 56.50 | 56.70 |
| T5 | 70.50 | 70.40 | 70.60 | 70.70 | 48.60 | 47.70 | 47.80 | 47.90 | 57.30 | 58.00 | 58.10 | 58.20 |
| T6 | 70.00 | 70.10 | 70.20 | 70.30 | 49.20 | 49.30 | 49.60 | 49.70 | 57.40 | 57.30 | 57.20 | 57.10 |
| CD (5%) | 1.39 | 1.54 | 1.68 | 1.88 | 6.22 | 7.04 | 8.00 | 8.26 | 4.65 | 4.67 | 4.75 | 4.79 |
| S.E M | 0.44 | 0.57 | 0.61 | 0.68 | 2.01 | 2.36 | 2.52 | 2.67 | 1.45 | 1.46 | 1.50 | 1.52 |

Table 3: Effect of various treatments on Ascorbic acid and Acidity of value added Pineapple candy (*Ananas comosus* L.)

| Treatment | Ascorbic acid (mg/100 g) | | | | Acidity (%) | | | |
|-----------|--------------------------|---------|---------|---------|-------------|---------|---------|---------|
| | Initial | 30 days | 60 days | 90 days | Initial | 30 days | 60 days | 90 days |
| T0 | 5.20 | 5.00 | 4.80 | 4.60 | 0.50 | 0.50 | 0.40 | 0.30 |
| T1 | 6.50 | 6.40 | 6.20 | 6.10 | 0.30 | 0.20 | 0.20 | 0.10 |
| T2 | 6.10 | 6.00 | 5.80 | 5.60 | 0.40 | 0.30 | 0.30 | 0.20 |
| T3 | 5.90 | 5.80 | 5.60 | 5.50 | 0.40 | 0.30 | 0.30 | 0.20 |
| T4 | 5.80 | 5.70 | 5.50 | 5.40 | 0.40 | 0.40 | 0.30 | 0.20 |
| T5 | 5.90 | 5.80 | 5.20 | 5.10 | 0.40 | 0.40 | 0.30 | 0.20 |
| T6 | 5.60 | 5.30 | 5.20 | 5.00 | 0.40 | 0.40 | 0.30 | 0.20 |
| CD (5%) | 0.70 | 0.66 | 0.58 | 0.49 | 0.24 | 0.16 | 0.14 | 0.07 |
| S.E. m | 0.24 | 0.22 | 0.19 | 0.16 | 0.09 | 0.06 | 0.05 | 0.03 |

Organoleptic attributes

Prepared pineapple candies packed in air tight boxes were evaluated for appearance and colour, flavour, taste, texture and overall acceptability by a panel of 15 semi-trained judges. The samples were rated on 9 point Hedonic Scale.

1. Colour: After 90 days of storage, significantly maximum

score for colour and appearance (7.60) (Table 4) recorded in T1; pineapple slices treated with 70% of sugar and 10% of Basil leaves. The colour and appearance recorded lowest (5.30) in treatment T0 [Control]. Similar results reported by Bankar *et al.* (2013) [3] in pineapple candy.

2. Texture: Regarding texture of the candy, after 90 days of

storage, result (Table 4) indicated significantly maximum scores (6.90) for Taste recorded in T1; pineapple slices treated with 70% of sugar and 10% of Basil leaves. The Taste recorded lowest (4.90) in treatment T0 [Control]. Sugar content of the treatments might have been optimum to better texture as sugar level in many sweet products can determine their smoothness or roughness.

- 3. Flavour:** After 90 days of storage, data pertaining to flavour of the candy revealed (Table 4) significantly maximum scores (7.90) for flavour recorded in T1; pineapple slices treated with 70% of sugar and 10% of Basil leaves. The Flavour recorded lowest (4.90) in treatment T0 [Control]. It appears that different treatments employed in the present study imparted unique flavour to candies which might have been liked by the sensory panel members. Similar observations reported by **Sultana *et al.* (2014)** in pineapple preserve and candy.
- 4. Taste:** After 90 days of storage of the pineapple candy revealed (Table 4) significantly maximum scores for

Texture (7.50) recorded in T1; pineapple slices treated with 70% of sugar and 10% of Basil leaves. The Texture recorded lowest (5.00) in treatment T0 [Control]. Similar reports were reported by **Golande *et al.* (2007)** ^[4] in sweet orange candy.

- 5. Overall acceptability:** All the organoleptic attributes were observed successfully within 90 days of storage duration and final acceptability scores indicated (Table 5) that treatment T1; pineapple slices treated with 70% of sugar and 10% of Basil leaves found best and recorded significantly the highest Overall Acceptability and treatment T0 (Control) recorded significantly the lowest Overall Acceptability. This clearly indicates the ability of judges in differentiating sensorial quality of the product. Variations in the sensory score due to variations in the product composition are noted by several workers (**Ritika and Seervartanam, 2012**) ^[10] in pineapple candy and preserve.

Table 4: Effect of various treatments on hedonic score: colour, texture and flavour of value added Pineapple candy (*Ananas comosus* L.)

| Treatment | Colour | | | | Texture | | | | Flavour | | | |
|-----------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | Initial | 30 days | 60 days | 90 days | Initial | 30 days | 60 days | 90 days | Initial | 30 days | 60 days | 90 days |
| T0 | 4.80 | 5.40 | 5.10 | 5.30 | 5.00 | 4.50 | 4.40 | 5.00 | 5.20 | 5.20 | 5.70 | 4.90 |
| T1 | 7.60 | 7.10 | 7.30 | 7.60 | 8.00 | 7.40 | 7.50 | 7.50 | 6.50 | 6.50 | 6.50 | 7.90 |
| T2 | 6.80 | 6.20 | 6.70 | 6.50 | 7.10 | 6.70 | 7.10 | 6.80 | 5.80 | 5.90 | 6.30 | 5.80 |
| T3 | 6.00 | 6.00 | 6.10 | 6.40 | 6.00 | 5.40 | 6.80 | 6.40 | 5.90 | 5.50 | 5.80 | 5.40 |
| T4 | 7.50 | 5.70 | 6.00 | 5.90 | 5.50 | 6.60 | 6.20 | 6.00 | 5.90 | 5.80 | 6.10 | 5.70 |
| T5 | 6.70 | 7.00 | 6.40 | 6.40 | 6.10 | 6.50 | 6.30 | 6.50 | 6.20 | 4.90 | 6.20 | 5.10 |
| T6 | 6.40 | 6.10 | 6.40 | 6.10 | 5.30 | 5.50 | 5.80 | 5.70 | 5.70 | 5.80 | 6.10 | 5.70 |
| S E. m | 0.42 | 0.33 | 0.39 | 0.45 | 0.52 | 0.47 | 0.38 | 0.56 | 0.36 | 0.33 | 0.31 | 0.38 |
| CD 5% | 1.29 | 1.17 | 1.20 | 1.38 | 1.63 | 1.42 | 1.35 | 1.72 | 1.08 | 1.01 | 1.00 | 1.10 |

Table 5: Effect of various treatments on score: Taste and Overall acceptability of value added Pineapple candy (*Ananas comosus* L.)

| Treatment | Score: Taste | | | | Score: Overall acceptability | | | |
|-----------|--------------|---------|---------|---------|------------------------------|---------|---------|---------|
| | Initial | 30 days | 60 days | 90 days | Initial | 30 days | 60 days | 90 days |
| T0 | 5.10 | 5.00 | 4.90 | 4.90 | 5.20 | 5.00 | 4.50 | 4.50 |
| T1 | 7.30 | 7.20 | 6.70 | 6.90 | 7.30 | 7.20 | 7.10 | 6.70 |
| T2 | 6.60 | 6.70 | 5.50 | 6.30 | 7.20 | 7.00 | 5.80 | 5.60 |
| T3 | 6.30 | 6.30 | 5.30 | 4.80 | 6.80 | 6.50 | 5.50 | 5.40 |
| T4 | 5.80 | 5.90 | 5.40 | 4.90 | 7.00 | 6.50 | 5.50 | 5.40 |
| T5 | 6.70 | 5.80 | 5.50 | 5.70 | 6.30 | 6.30 | 5.20 | 5.50 |
| T6 | 6.50 | 6.00 | 5.30 | 5.50 | 6.10 | 6.00 | 5.50 | 4.80 |
| S.Em | 0.44 | 0.38 | 0.35 | 0.29 | 0.65 | 0.45 | 0.19 | 0.30 |
| CD (5%) | 1.39 | 1.00 | 0.94 | 0.76 | 0.99 | 1.83 | 0.69 | 0.92 |

Conclusion

On the basis of results obtained in the experiment, it can be concluded that T1; pineapple slices treated with 70% of sugar and 10% of Basil leaves found best in terms of herbal Pineapple Candy product and recorded significantly the highest in terms of organoleptic attributes viz., Colour and appearance, texture, taste, flavour and overall acceptability and best in terms of Physico-chemical attributes. The maximum Benefit Cost Ratio (1.60) found in T1; pineapple slices treated with 70% of sugar and 10% of Basil leaves and the least B:C Ratio found with T4; Pineapple slice treated with 70% of Sugar and 10% of Cardamom. Pineapple candy can be stored for minimum 90 days with good retention of organoleptic quality and Market value. Since this is based on one season trail therefore, further evaluation trails are needed

to substantiate the findings.

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