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EFFECT OF PROCESSING CONDITIONS ON PHYSICOCHEMICAL ATTRIBUTES OF GREEN TEA (*CAMELLIA SINENSIS*) FORTIFIED PINEAPPLE FRUIT LEATHER

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Key words: *Hot air oven Dryer, Pineapple, Green tea, Fruit leather, Mixed fruit leather.*

Abstract– The present work aims to study the Effect of Processing Conditions on the Physicochemical attributes of Green Tea (*Camellia sinensis*) fortified Pineapple Leather. The drying process employed a hot air oven dryer with a blend of pineapple and green tea-fortified pulp, utilizing three distinct drying temperatures (70 °C, 80 °C, and 90 °C). The resulting fruit leather underwent comprehensive assessment for physicochemical, textural, microbial, and sensory properties. These properties encompassed titrable acidity, ascorbic acid content, color, taste, overall acceptability, and total plate count. The results indicate that the incorporation of green tea into the Pineapple Leather led to an increase in titrable acidity and ascorbic acid content. However, as temperatures increased, attributes including color, flavor, and overall desirability began to deteriorate. The analysis further revealed that the maximum values for total soluble solids, moisture content, ash content, ascorbic acid, titrable acidity, and total sugar content were recorded at 70.5° Brix, 18.04% (wet basis), 1.55%, 91.3 mg/100g, 0.42%, 4.88, and 45.96%, respectively. The resultant fruit leather not only enhances the processing value of both pineapple and the underutilized, highly nutritious green tea but also contributes to the amelioration of consumers' nutritional intake. This study underscores that the optimal temperature setting of the hot air oven substantially enhances the overall nutritional profile and acceptability of the final product.

INTRODUCTION

Pineapple (*Ananas comosus* L) stands out as a paramount commercial fruit crop replete with manifold health benefits. It finds its botanical home within the Bromeliaceae family, a significant presence in the realm of the American tropics, originating from South America. Recognized for its exceptional flavor and taste, pineapple has earned the epithet of the "queen of fruits." Fresh pineapple encompasses a consumable portion of approximately 60%, encompassing a moisture content that falls within the range of 80% to 85%. The fruit's composition includes sugars ranging from 12% to 15%, acid content at 0.6%, protein content of 0.4%, ash primarily comprising potassium (K) at 0.5%, a nominal 0.1% fat content, dietary fiber, and a spectrum of essential nutrients including vitamins A, C, beta-carotene, as well as a suite of antioxidants predominantly flavonoids, citric acid, and ascorbic acid (Moreira, 2021). Pineapple's culinary versatility spans from direct consumption to processed forms like squash, syrup, jelly, vinegar, and citric acid, among others. This fruit predominantly flourishes in regions such as the North East, West Bengal, Kerala, Karnataka, Bihar, Goa, and Maharashtra within the Indian subcontinent (Sarangi *et al.*, 2019). Green tea, a repository of antioxidants including the prominent catechin EGCG, emerges as a reservoir of potent health-enhancing attributes. Green tea extract is rich in polyphenols, offering health benefits like anti-inflammatory and potential anti-carcinogenic effects. It may improve memory, brain health, and skin conditions. There's potential for cellular health and cancer prevention, pending more research. It also helps lower hemoglobin and blood sugar levels while improving insulin sensitivity and blood sugar tolerance.

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MATERIALS AND METHODS

Procurement of raw material

To conduct the studies, well-matured pineapples (*Ananas comosus. L*) of uniform color and size were chosen. Sugar and green tea were acquired from Prayagraj's local market.

Preparation of Green Tea Fortified Pineapple Leather

The procedure began by washing and cutting fresh pineapples into small pieces, then grinding them into pulp and filtering it. The pulp was concentrated through a 10-minute boiling process. Next, the puree was blended with sugar and green tea to create various samples (T1-T9) with different green tea quantities (8 g, 10 g, and 12 g). The mixture was evenly spread onto steel trays. These samples were dried at three temperatures (70 °C, 80 °C, and 90 °C) for 8 to 10 hours. Once dried, the sheets were cut to size and packaged in L.D.P.E material for preservation at room temperature.

METHODS

Moisture content, ascorbic acid content, and titrable acidity were determined following AOAC (2005) standards. Total soluble solids and ash content were measured according to AOAC (2000) standards. The pH of the fruit leather was measured using a digital pH meter. Total sugar content was calculated using the Lane-Eynon method. Microbial count (Colony forming unit) of Green Tea Fortified Pineapple Leather was determined using the Total Bacterial Count method. This involved aseptically transferring 0.25ml of the sample, which was diluted to a 2×10^{-3} concentration, into petri dishes containing nutrient agar media. Control dishes with no sample were also prepared. The inoculated Petri dishes were then incubated at 37 °C for 48 hours. Colony-forming units (CFUs) were used to represent the microbial count, where each colony represented one microbe. Total plate counts were recorded after both 24 and 48 hours of incubation. The research employed a completely random design, with significance at a P-value of 0.05 or lower and insignificance at a P-value of 0.05 or higher. Statistical analysis was conducted using one-way ANOVA to assess the collected data's variation. The F-test was used to determine treatment effects.

RESULTS AND DISCUSSION

Drying Characteristics of Green Tea Fortified Pineapple Leather

The drying process of Green Tea Fortified Pineapple Leather was tested at three temperatures (70 °C, 80 °C, and 90 °C). As temperature increased, drying rate accelerated, shown by steeper slopes on the graph. Drying rate, (dm/dt), was calculated from moisture content and temperature. Two key takeaways: drying takes longest when moisture content is highest, and higher temperatures mean faster drying. The graph (Fig.1) confirms drying during the falling rate period, aligning with Lee's (2008) findings in strawberry leather study, reducing drying time.

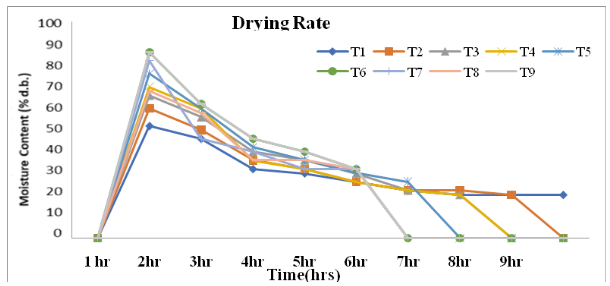

Fig. 1. Dry Rate Curves at different drying temperatures of Hot air oven.

Moisture Content

Sample T_5 had the highest moisture content at 18.6%, while T_1 had the lowest at 17.5%. Overall, moisture in green tea-fortified pineapple fruit leather ranged from 15.34% to 17.57%, with higher temperatures leading to lower moisture levels due to faster evaporation. These results differ slightly from Chavan *et al.* (2012), highlighting the need for further investigation into drying behaviors and conditions.

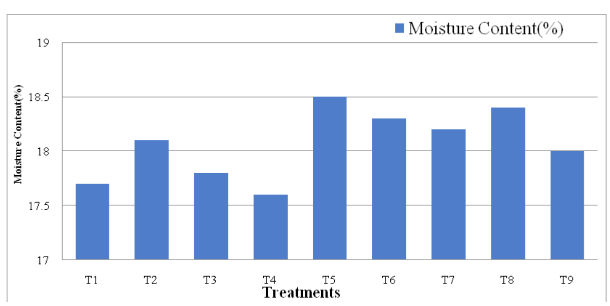

Fig.2. Moisture content of Green Tea Fortified Pineapple Leather

Rehydration ratio

The rehydration ratio of green tea-fortified pineapple leather were as follows for treatments T_1 to T_9: 1.75, 1.79, 1.82, 1.78, 1.83, 1.80, 1.76, 1.78, and 1.82% (Fig. 3). Treatment T_5 had the highest rehydration ratio at 1.83%, indicating better drying quality and potential preference in sensory analysis. Conversely, treatment T_1 had a lower rehydration ratio of 1.75%. A higher rehydration ratio signifies superior dried product quality, aligning with Shrivalli *et al.* (2016).

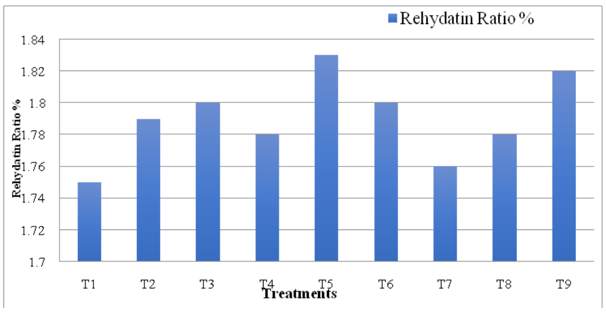

Fig. 3. Rehydration ratio of Green Tea fortified pineapple leather

Ascorbic Acid Content

The highest Vitamin C concentration was in T_8, at 90.5 mg/100g, while the lowest was in T3, with 82.2 mg/100g (Fig. 4). Temperature variations may have led to oxidative reactions, causing the decrease in ascorbic acid content. Ascorbic acid, a natural antioxidant, can degrade when exposed to factors like light and air, potentially forming dehydroascorbic acid. The decline in ascorbic acid levels might be due to processes like oxidation, especially in acidic environments like those with exposure to light and air. These findings align with those of Ashaye *et al.* (2009), confirming consistency between this study and prior research in the field.

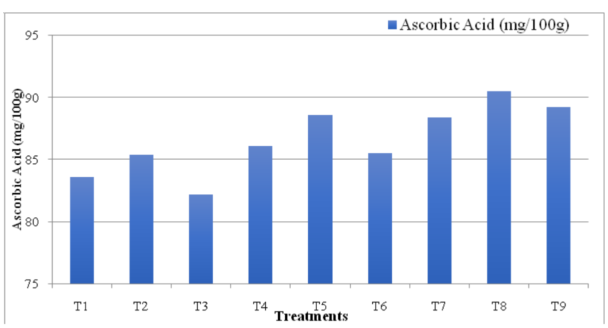

Fig. 4. Ascorbic acid content of Green Tea Fortified Pineapple Leather

Titrable Acidity

The content of titrable acidity spanned from 0.38% to 0.49%, with the T_6 sample displaying the highest titrable acidity and the T_3 sample presenting the lowest. The principal factor contributing to the observed variation in titrable acidity content was the disparate temperatures employed within the Hot Air Oven. Notably, higher temperatures often result in a reduction in the overall acidity content of food products. Titratable acidity encompasses the quantification of the cumulative acid concentration present within a given food product, serving as a comprehensive indicator of acidity levels (Nielsen, 2001).

Total Soluble Solid

The treatment denoted as T_8 exhibited the highest Total Soluble Solids (TSS) content among all treatments, registering at 72.20° Brix, while the lowest TSS content was noted in T_2, measuring 68.20° Brix. Notably, the increase in TSS content is closely linked to the reduction in moisture content. The process of drying leads to the concentration of sugars as moisture dissipates from the fruit, thus resulting in higher TSS values. This phenomena is explained by the fact that as moisture content decreases, the proportion of sugars in the remaining substance increases. This trend corresponds to findings observed by Phoung *et al.* (2016), further affirming the alignment of results between the present study and prior research efforts.

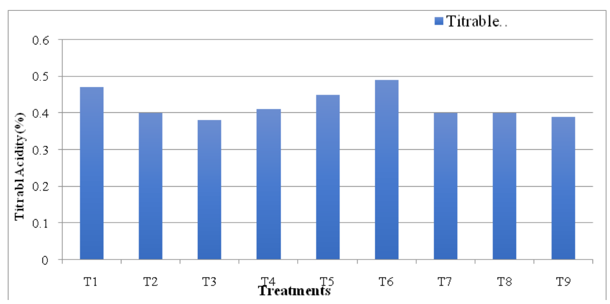

Fig. 5. Titrable acidity of Green Tea Fortified Pineapple Leather

Microbial Analysis

Microbial analysis was conducted on Green Tea fortified pineapple fruit leather to assess the presence of yeast and mold. The study was initiated during the initial storage period, revealing minimal microbial growth. A microbiological count of 2×10^{-3} colony-forming units per gram (cfu/g) was

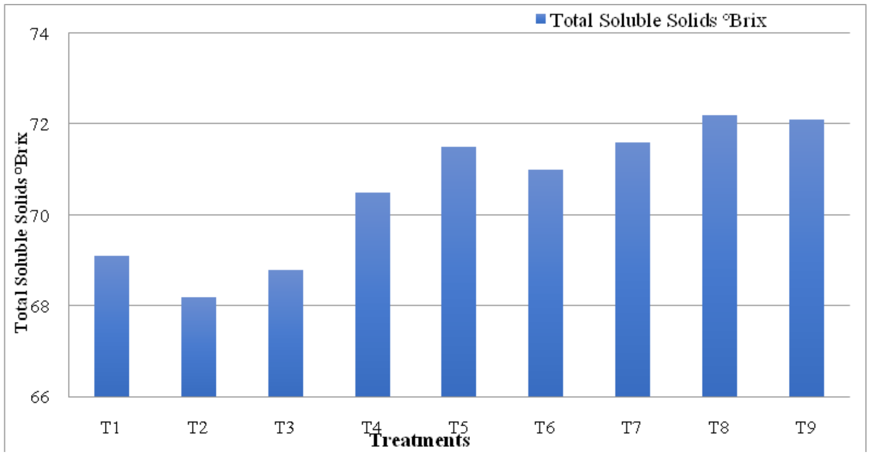

Fig. 6. Total Soluble Solid of Green Tea Fortified Pineapple Leather.

observed after 0 days of storage. The drying procedure's combined effects with the high sugar content, and both of which contribute to preventing microbial growth, can be used to explain this relatively small count. Yeast and Mold Count were included in further analysis for samples T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8, and T_9. At first, there was no Yeast and Mold Count found in the fresh leather samples. A little increase in the yeast and mold count was seen after 15 days of storage, with readings ranging from 1.1 to 1.69 cfu/ml. This count continued to increase within 2.74 and 3.49 cfu/ml after 30 days, and continued to increase within 2.74 and 3.49 cfu/ml after 45 days (Fig. 7). These results are more or less similar to results obtained by Abinash *et al.,* (2017).

CONCLUSION

The results of this study illustrate the important role that green tea fortification and drying temperature have in determining the characteristics of pineapple fruit leather that define its quality. Notably, Sample T_5, fortified with 10 gm of green tea extract and dried at 80°C, emerged as the most favorable formulation according to Physicochemical attributes. The enhanced antioxidant activity in the fruit leather samples was facilitated by the addition of green tea extract. These results provide valuable insights for the development of green tea-fortified fruit leather products, presenting an appealing blend of potential health advantages. It's important to highlight that the quality of the product exhibited a decline over the storage period, emphasizing the need for careful consideration of storage conditions and durations in product management. This study lays the foundation for further research aimed at optimizing formulation and processing conditions, seeking an optimal equilibrium between antioxidant

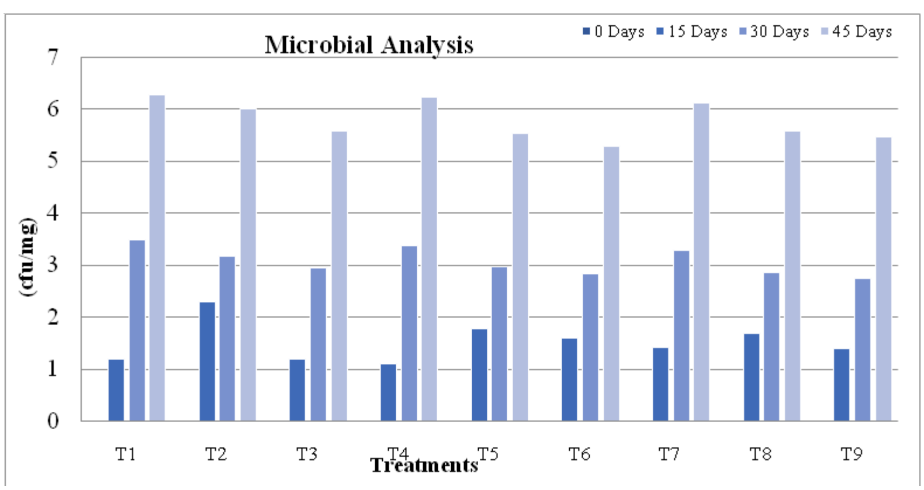

Fig. 7. Microbial Analysis of Green Tea Fortified Pineapple Leather

activity. Furthermore, exploring the potential health benefits associated with consuming green tea-fortified pineapple fruit leather, such as its implications for cardiovascular health or immune function, could yield valuable insights into its functional properties. In essence, green tea-fortified pineapple fruit leather stands poised as a promising addition to the market, offering consumers a delectable and nutritious alternative to conventional snacks, all while capitalizing on the well-documented health merits attributed to green tea consumption.

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