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Proceeding Paper

Development and Quality Evaluation of Dehydrated Kiwi Candy †

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Abstract: Kiwi fruit is a member of the "Actinidiaceae" family, with over 76 species and cultivars with a wide range of sensory attributes. The kiwi fruit is one of the most popular fruits in the world, and it is high in nutrients such as vitamins, phytochemicals, and minerals. Candies have a low nutritional value because of their principal constituents, which include gelling agents and sugar. In comparison to conventional candy, the goal of this project is to make a natural and healthy dehydrated candy utilizing fresh kiwi fruit. The fruits were obtained from the local market of Faisalabad. Two types of dehydrated kiwi candies were prepared (T1: peeled; T2: unpeeled). In the last step, the sweets were kept in a dehydrator at 50 degrees Celsius for 24 h. Candy's physiochemical, color measurements, and sensory characteristics were assessed. In all physio-chemical and sensory evaluations, the unpeeled candy produced the best results. The unpeeled candy's TSS value, titratable acidity, pH, and vitamin C content was 77.9°, 0.36%, 4.5, and 37 mg, respectively. Unpeeled candy has a slightly darker color as compared to peeled candy, and color values L*, a*, and b* were 43.89, 0.43, and 11.34, respectively. Candy's sensory study employing a nine-point hedonic scale reveals the highest consumer acceptability in terms of flavor, scent, mouthfeel, and texture.

Keywords: kiwi fruit; kiwi candy; peeled candy

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1. Introduction

Kiwifruit (*Actinidia deliciosa*) is a highly nutritious fruit due to its high vitamin C content and high antioxidant capacity due to a diverse array of phytonutrients such as flavonoids, carotenoids, lutein, phenolics, and chlorophyll [1].

Kiwifruit is one of the most popular fruits in the international market because of its excellent nutritional and therapeutic values, as well as its numerous health benefits. It is native to China and was transplanted in New Zealand in the year 1904, when it became one of the most recent fruit crops to attain international recognition and economic significance. With a yearly output of over 1.066 million metric tons (38.7% of global production) and an estimated planting area of 180,000 hectares (58% of the total global planting area), China is presently the world's leading kiwifruit producer. Kiwifruit juice, vinegar, wine, yogurt, jelly, and jam are all popular kiwifruit products in addition to fresh consumption. The kiwifruit is extremely nutritious and therapeutic and has several health advantages, such as anti-diabetic properties, anti-inflammatory properties, cardiovascular protective characteristics, laxative activity, and antibacterial activity. Kiwifruit, vinegar, juice, and wine were shown to be high in terms of vitamin C and polyphenols, with strong biological activity, although jam and dried kiwifruit slices included additional mineral elements. Kiwi fruits have an extremely limited shelf life due to their high perishability. The production of jams subjected

to a thermal procedure, such as pasteurization, is a viable option for extending the shelf life and storage period [2]. Green kiwifruit contains protein (1.14 g), fat (0.52 g), carbohydrates (14.7 g), fiber (3 g), sugars (9 g), ash (0.61), water (83.1 g), calcium (34 mg), iron (0.31 mg), magnesium (17 mg), phosphorus (34 mg), potassium (312 mg), vitamin C (80–120 mg). It provides 255 kj energy per 100 g [3].

Water is a dominant constituent in fruits, and its withdrawal prevents harmful physiochemical and microbial reactions, resulting in extended storage time. Hence, dehydration techniques enable us to preserve fruits and their products, extend their shelf life, and reduce their weight and volume, thus minimizing the packaging, storage, and transportation costs. Therefore, modifying the flavor and textural properties will result in a new product with a maintained or even improved final quality [4].

Therefore, this study aimed to make a natural and healthful dehydrated candy utilizing fresh kiwi fruit and a sensory evaluation of kiwi candy to check consumer acceptance.

2. Material and Methods

2.1. Procurement of Raw Material

Fresh, mature, and healthy kiwi fruits were obtained from the local market in Faisalabad and transported in corrugated soft board cartons to the Ayyub Agriculture Research Institute (AARI). Pectin, citric acid, sugar, sodium benzoate, and other necessary equipment such as glass bottles, a blender, a saucepan, spoons, a weight scale, stirrers, and so on were used to prepare candies. All chemicals used were of analytical grade (Sigma Aldrich, Taufkirchen, Germany).

2.2. Ingredients' Concentration

- Kiwi: 1 kg.
- Sugar: 1 kg.
- Water: half liter.
- Calcium chloride: 1 g.
- Citric acid: 4 g.
- Potassium meta-bi sulphate (KMS): 1 g.
- Sodium benzoate: 1 g.

2.3. Preparation of Raw Material

After washing and cleaning the fruits, half of the kiwi fruits were peeled, and half remained unpeeled. After that, we cut the kiwi fruit into slices and dipped them in a calcium chloride solution for 5 min.

2.4. Preparation of Kiwi Candies

Two types of kiwi candies were prepared. Both types of sliced kiwi fruit were dipped in citric acid and a KMS solution for 15–20 min. After that, they were dipped in sugar syrup (1 kg of sugar was added to 1 L of water) for 15 min. The brix of sugar syrup was 65. Then, the kiwi was blanched, placed in cloth, and kept in hot water for 3 to 4 min. Then, it was placed in a dry paper towel to drain any excess water. After, it was placed in a dehydrator at 50 °C for 24 h. Kiwi was removed from the dryer the next day, cooled, and ready to pack in jars [5], as seen in Figure 1.

2.5. Analytical Experiments

The prepared peeled and unpeeled candies were tested for their physiochemical measurements and color values. The total soluble solids measured with the refractometer were first were calibrated, and then the sample was prepared by dissolving candy into distilled water followed by mixing and filtration. Then, the refractive index was measured to calculate the candy TSS [6]. The pH of the candy was measured with a pH meter [7]. Vitamin C contents were determined using the 2,6-Dichlorophenol-Indophenol visual

titration method [8]. Color measurements were measured according to the CIE Lab system (L*, a*, b*) using a digital colorimeter [9]. Data were statistically analyzed.

Figure 1. Preparation of the two types of kiwi candies. Kiwi was removed from the dryer the next day, cooled, and ready to pack in jars.

3. Results and Discussion

The developed dehydrated (peeled and unpeeled) kiwi candy was subjected to physiochemical analysis and color measurements.

The comparison is outlined in Table 1.

Table 1. The developed dehydrated (peeled and unpeeled) kiwi candy was subjected to physiochemical analysis measurements.

Samples	TSS (Brix)	Acidity (%)	pH	Vitamin C
Peeled candy	71.450 ± 0.04	0.0823 ± 0.002	4.1100 ± 0.01	30.040 ± 0.03
Unpeeled candy	77.950 ± 0.02	0.3643 ± 0.004	4.55 ± 0.001	37.877 ± 0.15

Values expressed as the mean ± standard deviation derived from triplicate samples (n = 3) ($p < 0.05$).

The color measurements are highlighted in Table 2.

Table 2. The developed dehydrated (peeled and unpeeled) kiwi candy was subjected to color measurements.

Samples	L*	a*	b*
Peeled Candy	50.343 ± 0.02	3.2667 ± 0.01	22.233 ± 0.02
Un-Peeled Candy	43.857 ± 0.03	0.4633 ± 0.03	11.363 ± 0.02

Values expressed as the mean ± standard deviation derived from triplicate samples (n = 3) ($p < 0.05$).

Based on the results obtained, the study successfully achieved the goals of developing and evaluating the quality of dehydrated kiwi candy. The physio-chemical analysis provided insights into the candy's TSS (Brix), acidity, pH, and vitamin C content, while the color measurements (L*, a*, b*) allowed for a comprehensive evaluation of its visual characteristics. By comparing the peeled and unpeeled candy, the study examined the impact of different processing methods on the candy's sensory evaluation and consumer acceptance. The higher vitamin C content and slightly darker color of the unpeeled candy indicated its superior quality. Therefore, the study effectively demonstrated the development of dehydrated kiwi candy and evaluated its quality through various parameters, contributing to the understanding of this product's potential in the market.

4. Scope and Limitations

After analyzing the physio-chemical and color measurements of the developed dehydrated kiwi candy, it is important to acknowledge the scope and limitations of the study. The scope of this research paper focuses on comparing the peeled and unpeeled candy in terms of TSS (Brix), acidity, pH, vitamin C content, and color measurements (L*, a*, b*). The study provides valuable insights into the sensory evaluation and consumer acceptance of the candies, highlighting the preference for unpeeled candy due to its higher vitamin C content and slightly darker color. However, it is essential to acknowledge the limitations of this study. Firstly, the analysis was conducted on triplicate samples, which may not fully represent the entire population. Secondly, the study only considered the physio-chemical and color aspects without examining other factors such as texture or shelf life. Additionally, the research was conducted within a specific timeframe and location, which may limit the generalizability of the findings. Future studies could explore a wider range of factors and conduct experiments in different settings to further validate these findings.

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