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Research Article

Changes in Microbiological and Physicochemical Quality of Dried Persimmons (*Diospyros kaki* Thunb.) Stored at Various Temperatures

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This study was conducted to investigate the microbiological, physicochemical, and visual quality of dried persimmons (*Diospyros kaki* Thunb. cv. Cheongdo-Bansi) during storage at various temperatures in order to determine the shelf-life. Two commercial dried persimmon samples were evaluated for changes in weight, moisture content, color, texture (hardness and gumminess), and microbial populations during storage at different temperatures (−20, 5, 12, and 25°C) for 70 days. Overall, dried persimmon-2 showed lower levels of total mesophilic bacteria, *Escherichia coli*, coliforms, yeasts, and molds than dried persimmon-1. Among the physicochemical qualities, significant differences were observed in color parameters such as L^*, a^*, and b^* of the dried persimmons. However, no significant differences in weight, moisture content, and texture were observed in dried persimmons during storage for 70 days. Thus, changes in visual appearance and color index such as chroma value and browning index can be used as indicators for determining the shelf-life of dried persimmons.

1. Introduction

Recently, consumers demand for diet and healthy foods such as fruits and vegetables has increased. However, most of the fresh produce has a limited shelf-life [1]. The important quality changes of fruits and vegetables during storage such as tissue softening, off-flavors, and discoloration occur because of microbial growth, enzymatic degradation, loss of water, and so on [2, 3]. Drying is one of the oldest preservation techniques and commonly used by food industry. It consists on partial removal of water from foods, thus improving the food stability by inhibiting the growth of microorganisms and general deterioration reactions [4].

Persimmon (*Diospyros kaki* Thunb.) is one of the important fruits in East Asia including China, Japan, and Korea [5]. Traditionally, the drying of persimmons has been used as a traditional method to obtain a product with good sensory attributes as well as storage stability [6]. Dried food products could be contaminated with pathogenic microorganisms at various stages in production life cycle such as manufacturing, storage, transportation, wholesaling, and distribution [7]. Particularly, pathogenic molds have been identified in dried foods and considered as significant hazards. Several studies have investigated mycotoxins, isolated from dried fruits such as dried figs, apricots, plums, and raisins [8–10]. If the manufacturing operations in inadequate conditions including those associated with poor sanitation practices, poor operational practices, and inadequate ingredient control, some microorganisms that were initially present or those resulting from cross-contamination can survive and accelerate the degradation process [11]. Thus, it is important to moderate the microbial and physical quality of products in different markets in order to ensure optimal product quality and safety. Presently, the storage temperature recommended for dried persimmons is dependent on the manufacturer. However, shelf-life criteria for dried fruits have not been established. In general, microbiological, physicochemical, and sensory properties are considered for determining the shelf-life and quality of foods [12]. Major quality parameters associated with dried foods are the changes in color, visual appearance, microbial population abundance, texture, nutrients, and water activity [13, 14]. However, the quality parameters for determining the shelf-life and quality of dried foods have not been intensively investigated so far in persimmons. As dried persimmon is recommended to store at freezing temperature, several studies evaluated physicochemical and organoleptic quality change in dried persimmons during storage at freezing temperature [15–17]. However, determination of shelf-life could take a long time if the experiments are conducted at low temperature such as −20°C. Therefore, in this study, other higher temperatures such as 5, 12, and 25°C were tested for the accelerated shelf-life experiment as described in [12]. Therefore, this study assessed the microbiological, physicochemical, and visual quality of commercial dried persimmons during storage at various temperatures (−20, 5, 12, and 25°C) in order to obtain essential information for determining the shelf-life.

2. Materials and Methods

2.1. Sample Preparation and Storage Conditions. Two commercial dried persimmon samples (dried persimmon-1 and dried persimmon-2) produced by different drying methods from different manufacturers were provided from Korea Food Research Institute (Jeonju-si, Korea). Dried persimmon-1 and dried persimmon-2 were manufactured by vacuum drying and hot-cool air drying, respectively. Dried persimmon-1 (105 g) and dried persimmon-2 (200 g) were provided with complete sealing of the packaging film (polyethylene) and closed plastic box (polyethylene terephthalate), respectively, and both products were packaged in sliced pieces. When the weight of the packaging unit (a pack or box) of both products were measured, the actual weights (g) of dried persimmon-1 and dried persimmon-2 packaging units were 105.47 ± 2.64 and 201.70 ± 0.06 g, respectively (data not shown). For each measurement experiment, 22 packaging units of both products were stored in an incubator (SJ-503H, Sejong Scientific Co., Bucheon-si, Korea) at −20, 5, 12, and 25°C and analyzed for microbiological and physicochemical changes at 7-day intervals for 70 days. These temperatures were chosen based on the recommended storage temperature (−20°C) for dry persimmon, and high temperatures (5, 12, and 25°C) were chosen for accelerated testing. After storage for a certain period of time at each temperature, 10, 5, 25, and 25 g samples from a single packaging unit were measured and used for the measurement of microbial count, moisture content, color, and texture, respectively. Each experiment was duplicated using two packaging units for both products by each storage time.

2.2. Bacterial Enumeration. Two samples (10 g) were diluted each with 90 mL of 0.85% NaCl (Samchun Pure Chemicals Co., Gyeonggi-do, Korea) in a stomacher bag and homogenized with a stomacher (BagMixer 400, Interscience Laboratory Inc., St. Nom, France) for 2 min. After homogenization, the samples were serially diluted 10-fold in 9 mL of 0.2% peptone water (PW; Difco Laboratories, Detroit, MI, USA). Following dilution, 0.1 mL of each sample or diluent was plated onto Petrifilm Aerobic Count Plates (3M, St. Paul, MN, USA), Petrifilm *Escherichia coli* and Coliforms Count Plates, and Petrifilm Yeasts and Molds Count Plates to determine total mesophilic bacteria, *E. coli*, coliforms, yeasts, and molds. The plates were then incubated at 37°C for 24 to 48 h for total mesophilic bacteria, at 35°C for 24 to 48 h for *E. coli* and coliforms, and at 25°C for 3 to 5 days for yeasts and molds, followed by colony enumeration. Blue colonies with gas were considered as *E. coli*, and red colonies with gas bubbles were counted as coliforms. Also, small and pink-tan to blue-green colonies were counted as yeasts, and large and diffuse edge blue-green colonies were counted as molds. The lower limit of detection was 0.48 $\log_{10}$ CFU/g.

2.3. Weight (g), Water Activity (a_w), and Moisture Content (%). To determine the weight loss, dried persimmons in each sample were weighed using a digital balance (MW-1200, CAS, Gyeonggi-do, Korea). The initial a_w value of the samples (5 g) was determined with a water activity meter (LabMASTER-aw, Novasina Co., Lachen, Switzerland). Moisture content (%) was calculated by weight loss of the sample (5 g) maintained in a dry oven (MOV-212F-PK, Panasonic, Japan) at 105°C, until a constant weight was reached according to the ISO recommended standards 1442: 1997 [18]. Samples were allowed to cool in a desiccator before the weight of dried persimmons was recorded.

2.4. Color Measurement. The L^*, a^*, and b^* values (CIE-Lab) of samples (25 g) were measured during storage at 7-day intervals for 70 days at −20, 5, 12, and 25°C using a Hunter Lab Colorimeter (UltraScan PRO, HunterLab, Reston, VA, USA). Each fruit was measured ten times at different locations, and L, a, and b values were averaged. The instrument recorded the color of samples in the L^*, a^*, and b^* values color space, where "L^*" indicates the lightness, "a^*" indicates the redness/greenness, and "b^*" indicates the yellowness/blueness of the samples. Additionally, the chroma and browning index (BI) were calculated from the L^*, a^*, and b^* values and used to assess the color change during storage [19]:

$$\text{Chroma} = \left(a^{*2} + b^{*2}\right)^{1/2},$$
$$\text{BI} = \frac{[100\,(x - 0.31)]}{0.172}, \tag{1}$$

where $x = (a^* + 1.75L^*)/(5.645L^* + a^* - 3.012b^*)$

The chroma value indicates the strength (or intensity) of the color and represents the degree of color saturation [19]. BI is defined as purity of brown color and is one of the most common indicators of browning in foods containing sugar [20].

2.5. Texture Measurement. The texture of the dried persimmons (25 g) was determined by compression test using a texture analyzer (TAHDi/500, TAHD Co., Stable Micro System Ltd., London, UK). Textural parameters were taken as the force required for a 3 mm aluminum cylinder probe to penetrate the surface of dried persimmons. The compression level was set at 60% of the sample thickness. Force-time curves were recorded at a test speed of 5 mm/s and the crosshead speed was also 5 mm/s. Force versus time was recorded and hardness (N) and gumminess (N) were calculated [21]. These parameters were obtained using the Texture Expert Software (version 1.22, SMS). All tests were performed at room temperature three times with duplicate samples of dried persimmon.

2.6. Visual Quality. The visual quality of dried persimmon was observed during storage at 7-day intervals for 70 days at −20, 5, 12, and 25°C. Digital photographs were taken under a uniform fluorescent light at room temperature using a digital camera (Alpha-5000, Sony Corp., Tokyo, Japan).

2.7. Statistical Analysis. All experiments were repeated three times with duplicate samples of dried persimmon. For microbial analysis, the averages of plate counts from three replications were converted to $\log_{10}$ CFU/g. Data were analyzed using ANOVA in SAS software package (version 9.4, SAS Institute Inc., Cary, NC, USA) for a completely randomized design. When the main effect was significant ($p \leq 0.05$), the mean separation was accomplished using Duncan's multiple range test.

3. Results and Discussion

3.1. Microbial Populations in Dried Persimmons at Different Storage Temperatures. Populations (range and average) of total mesophilic bacteria, *E. coli*, coliforms, yeasts, and molds on the dried persimmons stored at −20, 5, 12, and 25°C are shown in Table 1. The initial populations of total mesophilic bacteria, coliforms, yeasts, and molds on dried persimmon-1 were 4.60 ± 0.26, 1.92 ± 0.47, 5.14 ± 0.31, and <0.48 $\log_{10}$ CFU/g, respectively. The initial populations of total mesophilic bacteria, coliforms, yeasts, and molds on dried persimmon-2 were 3.17 ± 0.70, 1.01 ± 0.88, 1.84 ± 0.65, and <0.48 $\log_{10}$ CFU/g, respectively. During 70 days of storage, *E. coli* was not detected on dried persimmons (<0.48 $\log_{10}$ CFU/g). Similar to the results of the present study, Kang et al. [16] reported that initial populations of total aerobic bacteria ranged from 2.71 to 4.36 $\log_{10}$ CFU/g on dried persimmons collected from farms in Sangju. The average populations of total mesophilic bacteria, coliforms, yeasts, and molds on dried persimmons were not significantly different at different storage temperatures (Duncan test, $p > 0.05$) during storage for 70 days. Thus, microbiological indices might not be a good criterion to assess the shelf-life of dried persimmons. Storage temperature is an important factor that affects the growth and survival of microorganisms in dried foods [22], but there were no observed microbial population changes according to the storage temperature in our study. Also, there was not any correlation between microbial populations and storage time for 70 days at all storage temperatures (data not shown). This might be because dry persimmons have low water activities (dried persimmon-1: 0.83 ± 0.02 and dried persimmon-2: 0.77 ± 0.01); therefore, microorganisms could not grow easily regardless of the storage temperature. Overall, the average microbial population of total mesophilic bacteria was higher in dried persimmon-1 than in dried persimmon-2. Similar to total mesophilic bacteria, the average microbial populations of coliforms, yeasts, and molds were higher in dried persimmon-1 than in dried persimmon-2. This is probably due to different process conditions such as drying method. Dried persimmons are usually dried by sun drying, and thus, major problems regarding color change, mold growth, and other damages occur during the drying process [5]. Dried persimmon-1 and dried persimmon-2 used in this study were manufactured by vacuum drying and hot-cool air drying, respectively. Vacuum drying is a drying technique in which drying is performed using low pressure. Air drying is one of the most frequently used techniques for preserving fruits and vegetables by removal of water from substances. Drying methods and process conditions affect the food quality such as color, density, texture, and nutrient contents [23, 24].

3.2. Physicochemical Properties in Dried Persimmons at Different Storage Temperatures. Table 2 shows the change in weight (g), moisture content (%), color, and texture (hardness and gumminess) in the dried persimmons during storage at −20, 5, 12, and 25°C. The initial a_w value was higher in dried persimmon-1 (0.83 ± 0.02) compared to that in dried persimmon-2 (0.77 ± 0.01) (data not shown). The initial moisture contents (%) of dried persimmon-1 and dried persimmon-2 were 34.07 ± 0.47 and 33.04 ± 0.59, respectively. Overall, no significant changes were observed in weight, moisture content, and texture in dried persimmon-1 during 70 days of storage at different temperatures ($p > 0.05$). Similar to dried persimmon-1, there were no significant changes in weight, moisture content, and texture in dried persimmon-2. This is probably due to the closed plastic boxes or perfect sealing of the packaging film of the commercial product without oxygen transmission into the package. Several studies have indicated loss of texture due to the action of endogenous enzymes on cell wall degradation and growth of microorganisms during storage [25, 26], but the initial levels of microorganisms were maintained for 70 days. Thus, physicochemical indices of quality (weight, moisture content, and texture) are not good criteria to assess the shelf-life of dried persimmons. On the other hand, the L^*, a^*, and b^* values of dried persimmon-1 and dried persimmon-2 were significantly decreased during 70 days of storage (Duncan test, $p \leq 0.05$) (Figure 1). In particular, L^* values of dried persimmon-1 and dried persimmon-2 were lower at 25°C than at −20, 5, and 12°C, indicating that dried persimmons stored at low temperatures are brighter than those stored at high temperatures (Figures 1(a) and 1(b)).

Table 1: Average and range (log_{10} CFU/g) of total mesophilic bacteria, coliforms, yeasts, and molds on dried persimmons during storage at different temperatures (−20, 5, 12, and 25°C) for 70 days.

Storage temperature (°C)		Total mesophilic bacteria		Coliforms		Yeasts		Molds	
		Dried persimmon-1	Dried persimmon-2	Dried persimmon-1	Dried persimmon-2	Dried persimmon-1	Dried persimmon-2	Dried persimmon-1	Dried persimmon-2
−20	Range	2.20–4.60	0.88–3.17	0.48–2.62	0.48–1.24	3.23–5.51	1.05–4.88	0.48–5.80	0.48–4.96
	Average ± SD	3.31 ± 0.72^{Aa}	2.11 ± 0.63^{Aa}	1.41 ± 0.62^{Aa}	0.66 ± 0.27^{Aa}	4.85 ± 0.71^{Aa}	2.83 ± 1.16^{Aa}	4.68 ± 1.42^{Aa}	2.85 ± 1.29^{Aa}
5	Range	2.20–4.60	0.72–3.17	0.48–1.92	0.48–1.01	0.72–5.70	0.98–4.12	0.48–5.81	0.48–4.01
	Average ± SD	3.18 ± 0.75^{Aa}	1.56 ± 0.65^{Ab}	0.87 ± 0.48^{Aa}	0.57 ± 0.20^{Aa}	4.32 ± 1.25^{Aa}	2.34 ± 0.96^{Aa}	4.20 ± 1.88^{Aa}	2.26 ± 1.04^{Aa}
12	Range	0.04–4.60	0.55–3.17	0.48–1.92	0.48–1.09	3.81–5.32	0.60–3.74	0.48–5.89	0.48–3.28
	Average ± SD	2.53 ± 0.90^{Aa}	1.31 ± 0.84^{Aa}	0.61 ± 0.41^{Aa}	0.58 ± 0.22^{Aa}	4.66 ± 0.44^{Aa}	2.04 ± 0.96^{Ab}	4.50 ± 1.47^{Aa}	2.13 ± 0.78^{Aa}
25	Range	0.55–4.60	0.67–3.17	0.48–1.92	0.44–1.01	2.55–5.41	1.84–3.48	0.48–5.38	0.48–1.89
	Average ± SD	1.64 ± 1.50^{Aa}	1.71 ± 1.04^{Aa}	0.77 ± 0.58^{Aa}	0.69 ± 0.23^{Aa}	4.61 ± 1.05^{Aa}	2.52 ± 0.71^{Ab}	4.24 ± 1.89^{Aa}	1.06 ± 0.60^{Ab}

Means with the same uppercase letter within a column were not significantly different ($p > 0.05$). Means with the same lowercase letter in the same row were not significantly different ($p > 0.05$).

Average L^* values on both samples were not significantly different at −20, 5, and 12°C ($p \leq 0.05$) except for 25°C during storage for 70 days. Initial a^* values of dried persimmon-1 and dried persimmon-2 were 18.75 ± 0.04 and 21.23 ± 3.22, respectively (Figures 1(c) and 1(d)). After 70 days of storage at −20°C, the a^* values of dried persimmon-1 and dried persimmon-2 were 14.97 ± 2.32 and 16.24 ± 4.56, respectively, whereas the a^* values of those stored at 5, 12, and 25°C rapidly decreased after 70 days (Figures 1(c) and 1(d)). In particular, the a^* values of dried persimmon-1 and dried persimmon-2 were significantly decreased ($p \leq 0.05$) when they were stored at 25°C for 28 and 21 days and resulted in 6.37 ± 0.96 and 9.53 ± 1.29, respectively. Similar to the a^* values, the b^* values showed similar results. According to these results, storage at low temperatures such as −20°C was effective in maintaining the color quality of dried persimmons during 70 days of storage. According to Hur et al. [17], the L^*, a^*, and b^* values of dried persimmons from Chengdu were 31.26 ± 0.57, 6.46 ± 0.14, and 25.25 ± 0.77, respectively, which are higher L^*, a^*, and b^* values compared to the result of this study. The differences in these values are probably due to differences in persimmon cultivars and processing methods such as drying method [23], drying temperature [27, 28], and type of packaging method [29]. In other words, storage temperature of dried foods is important to prevent color changes during storage. Choi et al. [5] observed that the L^*, a^*, and b^* values were significantly decreased in semidried persimmons during storage for 20, 25, and 80 days at 10, 0, and −10°C, respectively. Cárcel et al. [14] also reported that the color change in dried persimmons was reduced at 2°C (ΔL^* −12.0%) than at 28°C (ΔL^* −46.4%) after storage for 409 days.

3.3. Color Index. Color indices (chroma value and browning index (BI)) are shown in Figure 2. Chroma values of dried persimmons decreased significantly after 70 days of storage ($p \leq 0.05$), indicating a loss in color saturation for stored dried persimmons (Figures 2(a) and 2(b)). After 28 days of storage, the chroma value of dried persimmon-1 decreased from 733.92 ± 18.93 to 609.54 ± 17.70 at −20°C, whereas the chroma value decreased from 733.92 ± 18.93 to 65.71 ± 14.87 at 25°C. Similar to dried persimmon-1, the chroma value of dried persimmon-2 also significantly decreased depending on the storage temperature ($p \leq 0.05$). A similar trend was observed in BI (Figures 2(c) and 2(d)). Based on the results of color, the use of color index as quality parameters could be a way to determine the shelf-life of dried foods. Color is a major quality attribute in dried foods [30, 31]. Arnal and Del Río [13] evaluated the persimmon quality based on the L^*, a^*, and b^* values during storage. Quitão-Teixeira et al. [32] evaluated chroma and BI to control the quality of carrot juice. Moreover, several studies have indicated that the color index estimates the quality in fruits such as dried kiwifruits [19], dried banana and dried guava [31], hebezu fruit [33], and minimally processed apple [34].

3.4. Visual Quality. Digital photographs were taken of dried persimmons stored at different temperatures (−20, 5, 12, and 25°C) to assess the visual quality (Figure 3). After storage for 7 days at 25°C, the visual quality of the dried persimmons was adversely affected, where darkening of the both products was more pronounced under 25°C than −20, 5, and 12°C. In particular, growth of mold was observed on the surface of dried persimmon after 14 days of storage at 25°C. Undesirable appearance was observed in dried persimmon-1 stored for 14 days at 5 and 12°C, whereas undesirable appearance in dried persimmon-2 was confirmed when they stored at 5 and 12°C for 28 and 21 days, respectively. On the other hand, the surface of both products did not show adverse visual quality until 70 days of storage at −20°C.

Rocha and Morais [34] observed that color (L^* and a^* values) was highly correlated with visual appearance in minimally processed apples during 10 days of storage at 4°C. Generally, a decrease in L^* value and an increase in a^* value indicate the degree of browning [35]. In the previous study, browning occurred at water content of about 50% or less [36], indicating that water loss was excessive at high temperatures. Several studies also suggested a direct

Table 2: Change in physicochemical properties (weight, moisture content, and texture) on dried persimmons during storage at different temperatures (−20, 5, 12, and 25°C) for 70 days.

Storage temperature (°C)		Weight (g)		Moisture content (%)		Hardness (N)		Gumminess (N)	
		Dried persimmon-1	Dried persimmon-2	Dried persimmon-1	Dried persimmon-2	Dried persimmon-1	Dried persimmon-2	Dried persimmon-1	Dried persimmon-2
−20	Range	98.95–115.14	153.93–206.21	28.88–54.55	24.26–42.08	0.02–5.43	0.02–7.95	0.00–5.25	0.00–3.25
	Average ± SD	104.26 ± 3.98^{Ab}	199.14 ± 10.33^{Aa}	35.79 ± 4.36^{Aa}	33.41 ± 3.65^{Aa}	1.07 ± 1.23^{Aa}	1.18 ± 1.42^{Aa}	0.37 ± 0.61^{Aa}	0.38 ± 0.59^{Aa}
5	Range	97.7–107.34	194.41–205.75	31.76–40.61	22.29–40.44	0.04–6.09	0.02–8.39	0.01–5.25	0.00–3.11
	Average ± SD	101.68 ± 2.24^{Ab}	201.37 ± 2.26^{Aa}	35.69 ± 2.33^{Aa}	33.44 ± 3.69^{Aa}	1.34 ± 1.49^{Aa}	1.61 ± 1.77^{Aa}	0.54 ± 0.77^{Aa}	0.50 ± 0.64^{Aa}
12	Range	97.09–108.26	192.21–205.78	17.23–52.79	27.59–39.62	0.04–5.45	0.02–8.22	0.00–5.25	0.00–4.79
	Average ± SD	102.17 ± 3.80^{Ab}	199.15 ± 3.46^{Aa}	34.53 ± 4.43^{Aa}	33.48 ± 2.61^{Aa}	1.15 ± 1.45^{Aa}	1.44 ± 1.68^{Aa}	0.44 ± 0.73^{Aa}	0.47 ± 0.70^{Aa}
25	Range	96.71–107.34	194.58–207.44	31.41–44.88	29.82–44.26	0.03–5.43	0.02–5.70	0.01–5.25	0.00–3.66
	Average ± SD	100.70 ± 3.46^{Ab}	200.72 ± 3.85^{Aa}	35.39 ± 3.63^{Aa}	34.85 ± 3.42^{Aa}	1.20 ± 1.37^{Aa}	1.20 ± 1.52^{Aa}	0.53 ± 0.90^{Aa}	0.42 ± 0.68^{Aa}

Means with the same uppercase letter within a column were not significantly different ($p > 0.05$). Means with the same lowercase letter in the same row were not significantly different ($p > 0.05$).

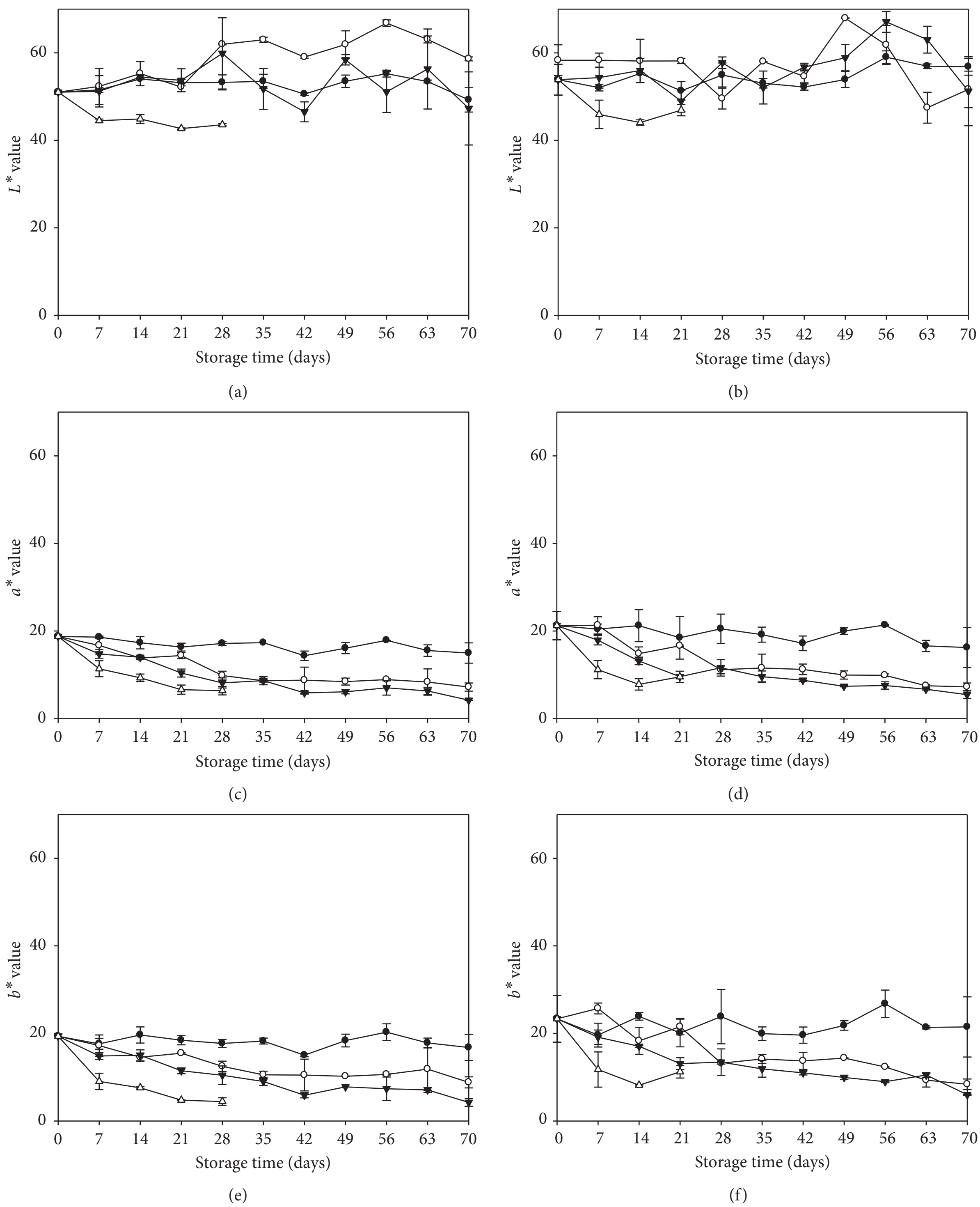

Figure 1: Change of color (L^*, a^*, and b^* values) in dried persimmon-1 and dried persimmon-2 during storage at different temperatures (−20, 5, 12, and 25°C) for 70 days. Dried persimmon-1 (a, c, e) and dried persimmon-2 (b, d, f). L^* value (a, b), a^* value (c, d), and b^* value (e, f). ●, −20°C; ○, 5°C; ▼, 12°C; △, 25°C.

correlation between the visual appearance and color index in specific foods including fruit, juices, flour, bread, pasta, and mashed potato [37, 38]. These color indices such as chroma, BI, ratio a^*/b^* value, and whiteness are highly correlated with the visual color on the surface of the fruits. Therefore, these results suggest that visual quality in combination with color index may provide useful information for determining the shelf-life of dried persimmons.

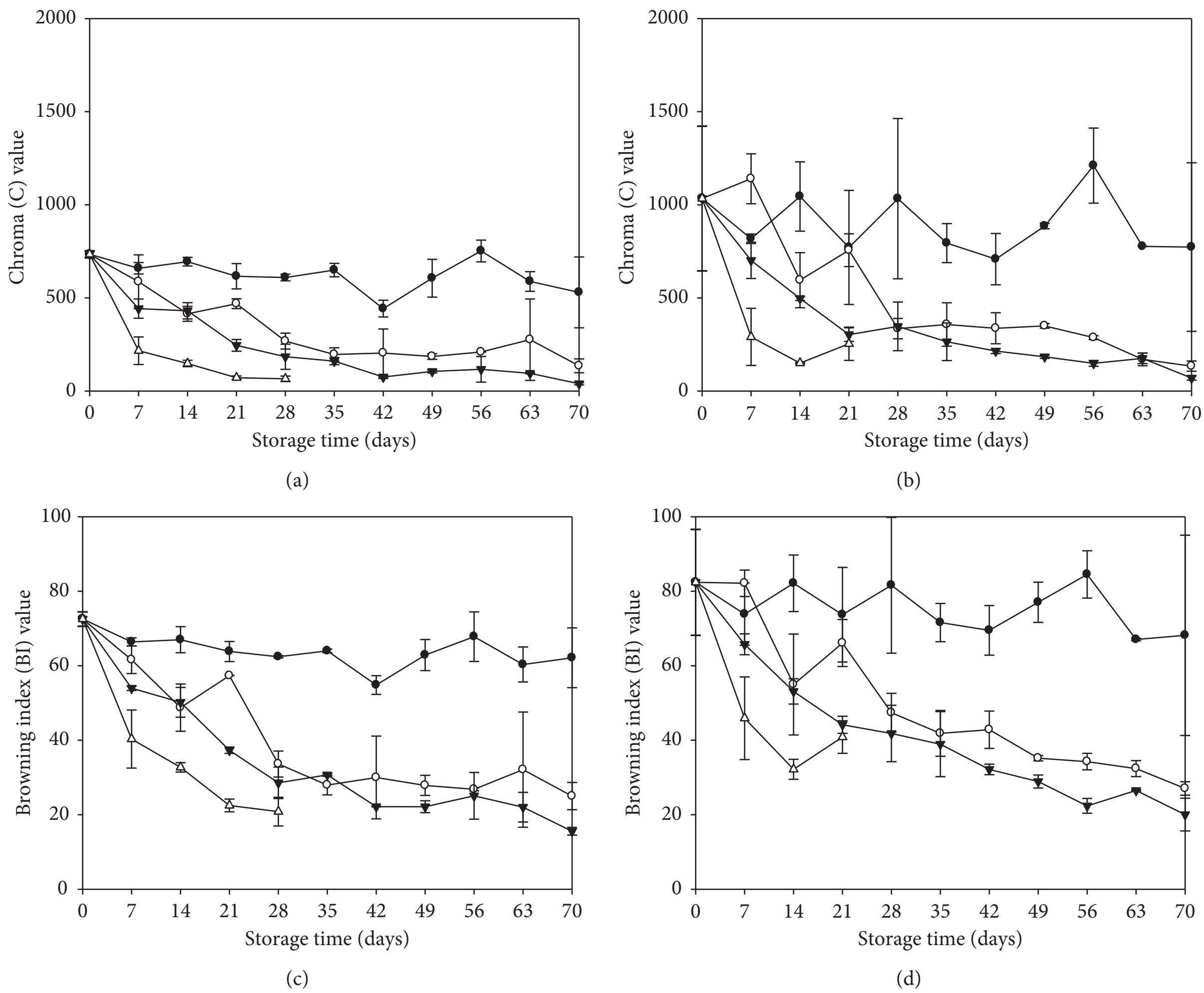

Figure 2: Change of chroma (a, b) and browning index (c, d) in dried persimmon-1 and dried persimmon-2 during storage at different temperatures (−20, 5, 12, and 25°C) for 70 days. Dried persimmon-1 (a, c) and dried persimmon-2 (b, d). ●, −20°C; ○, 5°C; ▼, 12°C; △, 25°C.

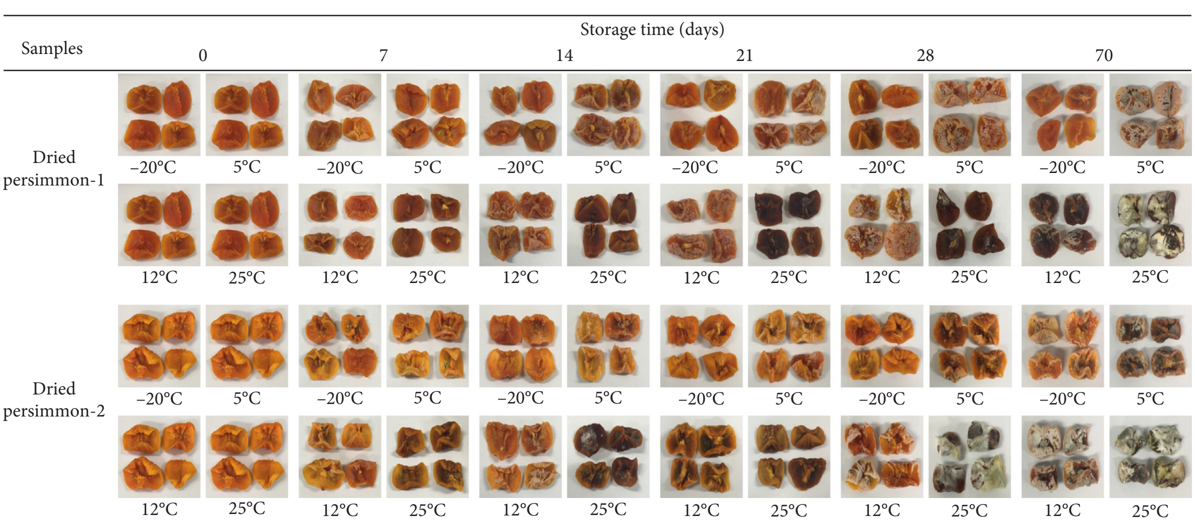

Figure 3: Digital photographs of dried persimmon-1 and dried persimmon-2 during storage at different temperatures (−20, 5, 12, and 25°C) for 70 days.

4. Conclusion

In conclusion, the results of this study indicate that visual appearance and color index can be used as factors for determining the shelf-life of dried persimmons at different temperatures. Further studies investigating other quality parameters such as color, visual appearance, flavor, water activity, texture, microbial load, retention of nutrients, and chemical stability to determine the shelf-life of dried foods need to be conducted. Moreover, producers, processors, and distributors must adopt good hygienic practices and adequate temperature control in order to prevent microbial contamination during the entire food production chain.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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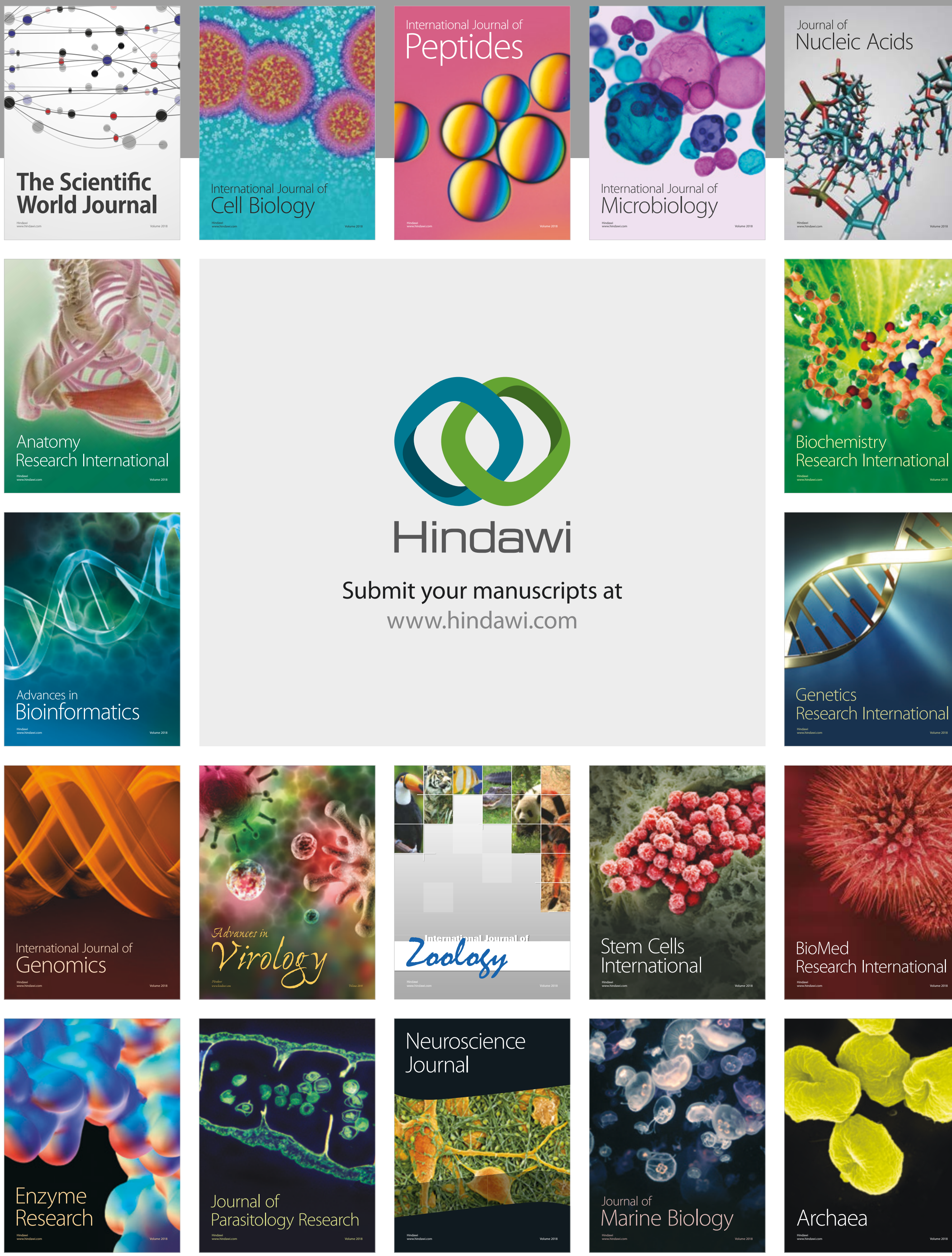
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