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Evaluation of drying conditions on the quality properties of dried kiwi slices

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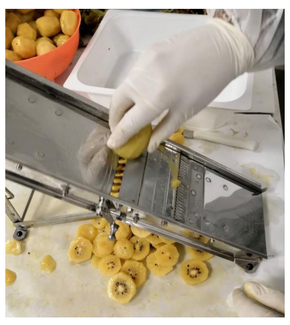
INTRODUCTION

Fruits and vegetables are products which can be consumed in its raw form without undergoing processing or transformation. Drying is one of the oldest methods of food preservation. It is still used widely to preserve foods for home consumption and for sale (Ratti, 2001). Dried fruits are one of the most popular products made by small-scale processors. The health benefits of consuming fruit are well documented [2]. Kiwifruit (*Actinidia deliciosa* cv Hayward) is a nutrient-dense fruit and extensive research over the last decade on its health benefits has linked its regular consumption to improvements not only in nutritional status, but also benefits to digestive, immune and metabolic health. Dried kiwis are highly needed in food industries. The dehydration process removes much of the water content from kiwi slices, making richer in nutrients. This work aimed to evaluate the effect of the air-drying temperature on quality and nutritional compounds of dehydrated kiwi slices, during 120 days of storage.

MATERIALS AND METHODS

Drying Processes

Kiwifruits (*Actinidia deliciosa* cv. Sungold) at commercial maturity stage were obtained from a farm in Calabria (Cosenza, Italy) in February 2020. Homogenous samples (15 kg) washing with a solution of sodium hypochlorite were peeled and cut vertical to their axis into cylindrical slices of 7 mm thickness using a mechanical cutter. The drying process was carried out in a convective dryer set to two different temperatures, 40°C and 55°C, to final moisture content of 12% from initial moisture content of about 80%. The dried samples were stored in sealed containers at 25°C. Physiological and biochemical parameters were analyzed at fixed time for 120 days.



Preparation of extracts

For determination of chemical parameters, the fruits were homogenised in a common blender, and 5 g of the sample was added to 50 ml of distilled water centrifuged (5000 rpm for 10 min). Supernatant solution was filtered through a paper and analysed.

Physicochemical analysis

For the extracts, titratable acidity, expressed as g of citric acid 100 g^{-1}dw, and pH (with a pH meter Crison GLP, Barcelona, Spain) were measured according to the AOAC method. A digital refractometer PR-201α (Atago, Milan, Italy) was used for total solid soluble content (TSS). Results were expressed as °Brix. Water activity (aw) was measured by means of the AquaLab LITE (Decagon, Inc., Washington, USA) instrument.
Ten,fruits were used for the color analysis and color parameters (L*, a* and b*) were measured on 3 different points on the cut surface for a total of 30measures for each treatment. A colorimeter (CR-400, Konica Minolta, Osaka, Japan) equipped with the D65 illuminant, in the reflectance mode and in the CIE L* a* b* color scale was used. The color parameters were used to calculate the Browning index.

Bioactive compounds and antioxidant activity

For the estimation of Total Phenolic Compounds (TPC), Total Flavonoids Content (TFC) and Antioxidant Activity (DPPH and ABTS+ assay), *Actinidia deliciosa* fruits were were homogenised in a common blender, and 5 g of the sample was added to 25mL of methanol : water (80 : 20, v : v), mixed, and then centrifuged at 5000 rpm for 10 min according to the method of Sicari et al; 2019 with some modifications. The methods of Izli et al; 2019 with appropriate modifications was followed to determine total phenolic content. 250 µL of Kiwifruit extract was mixed with Folin-Ciocalteu reagent and Na_2CO_3 (7.5% w/v). the determination of Flavonoids content was carried out mixing 0.5 mL of extract and 0.3 mL of 0.5 mol L^{-1} sodium nitrite solution for 3 min; then 0.3 mL of 0.3 mol/L aluminum chloride solution, 2 mL of 1 mol L^{-1} sodium hydroxide solution, and water to 5 mL were added sequentially and rested for 10 min, the absorbance was measured at 510 nm. The antioxidant activity was determined using DPPH test as reported by Brand-Williams et al; 1995 .

RESULTS AND DISCUSSIONS

This work aimed to evaluate the effect of the air-drying temperature on quality and nutritional compounds of dehydrated kiwi slices, during 120 days of storage. Hot air drying of kiwi slices was investigated at drying temperature ranged from 40°C to 55°C and slice thickness of 4 mm. Fresh and dried kiwi slices were analysed for their pH, activity water, total solid soluble (TSS), colour, titratable acidity, ascorbic acid content, total phenols and flavonoids content as well as radicals scavenging activities evaluated by ABTS test [3,4]. The analysis carried out on the dehydrated kiwifruit have shown a good disposition of the kiwi towards the drying process. Particularly, it has been observed that drying treatment at low temperature allowed to preserve the nutraceutical properties of the food matrix. Samples treated at 40°C (Tab. 2 and 1),showed the highest values of total phenols and flavonoids content with values of 2179 mg/100g dried weight (DW) and 281 mg/100 DW fruits, respectively. This high phytochemical content is responsible of the dried kiwifruit promising antioxidant activity (1657 mmol Trolox/100g DW fruits).

Physicalchemical parameters	
aw	0.99±0.00
pH	3.19±0.04
°Brix	14.5±0.08
Total acidity (g 100g^{-1}dw)	1.51±0.00
L	58.57±4.37
a*	1.19±0.78
b*	15.34±3.07
Bioactive compounds and antioxidant activity	
TPC (mg GAE 100g^{-1}dw)	541.79±4.49
TFC (mg CTE 100g^{-1}dw)	160.19±6.22
DPPH (mmol Trolox 100g^{-1}dw)	1195.87±15.19
ABTS (mmol Trolox 100g^{-1}dw)	56.05±3.06

Tab. 1. Physicochemicol parameters and bioactive compounds of fresh kiwi

	aw	pH	TSS (°Brix)	Total acidity (g citric acid 100g^{-1}dw)	Browning index
T0	0.45±0.01c	3.56±0.01b	2.43±0.06b	0.34±0.01e	50.57±9.48
T30	0.40±0.00d	3.56±0.01b	4.87±0.12a	0.75±0.01a	56.20±14.38
T60	0.47±0.00b	3.51±0.00b	4.37±0.23a	0.68±0.00b	55.07±13.40
T90	0.47±0.00b	3.56±0.02b	4.80±0.00a	0.63±0.03c	49.88±10.20
T120	0.52±0.00a	3.70±0.06a	4.27±0.46a	0.58±0.00d	49.92±10.62
Sign.	**	**	**	**	ns

Tab. 2. Physicochemicol parameters of kiwi slices dried at temperature of 40 °C

	TPC (mg GAE 100g^{-1}dw)	TFC (mg CTE 100g^{-1}dw)	DPPH (mmol Trolox 100g^{-1}dw)	ABTS (mmol Trolox 100g^{-1}dw)
T0	2179.42±2.40a	281.84±2.17a	1657.62±0.92a	64.68±0.34a
T30	650.54±2.32b	273.84±2.04b	1318.95±6.62b	61.49±2.95ab
T60	586.64±2.05c	243.64±3.70c	1241.47±1.39c	58.00±0.82c
T90	495.14±5.43d	116.05±0.99d	1024.68±4.37d	55.93±3.76c
T120	395.34±0.85e	113.93±1.12d	996.79±2.63e	42.29±1.61d
Sign.	**	**	**	**

Tab. 3. Bioactive compounds and antioxidant activity of kiwi slices dried at temperature of 40°C

	aw	pH	°Brix	Total acidity (g citric acid 100g^{-1}dw)	Browning index
T0	0.50±0.00ab	3.52±0.01ab	5.38±0.03a	0.76±0.07b	57.09±8.11
T30	0.44±0.00c	3.54±0.01a	3.5±0.00e	0.69±0.00b	55.00±10.54
T60	0.44±0.00c	3.37±0.02c	5.17±0.06b	0.93±0.04a	57.22±10.21
T90	0.51±0.00a	3.44±0.00cd	4.03±0.05d	0.73±0.04b	46.29±8.91
T120	0.49±0.00b	3.46±0.05c	4.30±0.00c	0.72±0.00b	51.19±10.91
Sign.	**	**	**	**	ns

Tab. 4. Physochemical parameters of kiwi slices dried at temperature of 55°C

	TPC (mg GAE 100g^{-1}dw)	TFC (mg CTE 100g^{-1}dw)	DPPH (mmol Trolox 100g^{-1}dw)	ABTS (mmol Trolox 100g^{-1}dw)
T0	526.04±2.40a	169.07±5.27a	926.15±2.75a	670.59±1.68a
T30	472.27±4.80b	166.37±3.50a	891.13±5.13b	52.70±2.37b
T60	456.82±3.18c	165.33±2.78a	889.00±2.95b	45.96±0.24c
T90	453.15±2.64c	116.60±2.90b	859.32±1.49c	39.54±1.39d
T120	408.25±2.11d	102.78±1.61c	854.35±1.30c	36.71±0.52d
Sign.	**	**	**	**

Tab. 5. Bioactive compounds and antioxidant activity of kiwi slices dried at temperature of 55°C

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