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Effect of Storage Temperature on the Nutritional Value of Curry Leaf

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INTRODUCTION

Curry leaf (*Murraya koenigii* Spreng., Rutaceae), is a popular leafy-spice used in Asian-Indian cuisine for its characterizing authentic flavor and distinct aroma (Fig. 1). The curry leaf is used by Asian Americans originating from South Asia almost daily in its fresh form when available and is preserved as dried or frozen for long-term storage. Interest in greater use of curry leaf has been stimulated since its high antioxidant and anticarcinogenic potential were reported (Khan et al. 1997; Khanum et al. 2000), as well as the changing demographics nationwide that have created a ready market and greater demand for this spice (Palaniswamy 2001). Curry leaf is used in very small quantities for its distinct aroma due to the presence of volatile oils and as a result most studies report on the concentrations of volatile oils and not on the nutritional value and functional properties attributed to antioxidant vitamins and plant pigments. The objective of this study was to evaluate the locally available curry leaves as a source of α-tochopherol, β-carotene, and lutein and study the effect of storage temperature on the concentrations of these vitamins and plant pigments.

METHODOLOGY

Postharvest Treatments for Study

Curry leaf was purchased from local Asian grocery stores, pooled, divided into four lots, and sampled as (1) freshly bought, (2) oven-dried at 60°C for 1 day, (3) air-dried for 10 days spread on a table at 22°C, and (4) sealed in polythene bags and frozen at –15°C for 10 days. The freshly bought leaf was analyzed the same day of purchase, while the other samples were analyzed ten days after purchase when all the treatments were completed. The air-dried and the oven-dried samples were put in glass bottles when completely dried to imitate the traditional method of home storage for culinary use.

Leaf Vitamin Extraction and Sample Preparation

The vitamins were extracted form the leaf tissue as given by Sommerburg et al. (1998). Leaf tissue (1 g) was homogenized for 3 min in 20 mL sodium phosphate (10 mM) containing 0.15 N sodium chloride (pH 4.7); 2 mL of methanol containing 0.5 mg/mL butylated hydroxytoluene and 10 mL internal standard (1 mg/mL) in

Fig. 1. Curry leaf.

hexane were added, vortexed for 5 min, and centrifuged for 10 min. The upper layer was collected and stored. The remaining extract was vortexed again for 2 min and centrifuged for 5 min. The upper layer was collected and combined with the first extract. The combined extracts were passed through sodium sulfate to remove moisture. All extracts were transferred and stored in 4 mL amber vials, sealed, and refrigerated.

Chlorophyll Measurement

At the time of chemical analysis, the fresh curry leaves as well as the leaf samples that received the different postharvest and storage treatments were extracted with N, N-dimethylformamide and the chlorophyll content was determined by the method of Inskeep and Bloom (1985).

High Performance Liquid Chromatography

A Restek reversed phase Ultra C18 column (150 mm, 4.6 mm i.d., 5 mm particle size; Restek Corporation, Bellefonte, Pennsylvania) with a 20% carbon load, along with a Ultra C18 Guard column (10 mm, 4 mm i.d, 5 µm packing) and 50 µL injection loop (Rheodyne Inc, Cotati, California) were used with a HPLC (Perkin Elmer Binary LC Pump Model 250, PE Biosystems, Norwalk, Connecticut) fitted with a Perkin Elmer Diode Array Detector Model 235, set at the wavelengths of 270 nm for β-carotene and lutein, and 290 nm for α-tocopherol and α-tocopherol acetate as internal standard with an attenuation of 0.2 absorbance units. Monitoring at higher wavelengths caused detector saturation. The column was placed in a Perkin Elmer Oven Model 101 set at 35°C, and the data collected on a computer (PE Nelson Model 1022 LC computer). Two solvents were prepared for the mobile phase. A rapid 20 min gradient of 90% solvent mixture A: 85% acetonitrile, 2.5% hexane, 2.5% methylene chloride, and 10% methanol followed by 20 minutes of 100% solvent B: 50% acetonitrile, 20% hexane, 20% methylene chloride, and 10% methanol at a flow rate of 1 mL min^{-1} was used. The column was allowed to equilibrate prior to the next injection with a 25-min gradient of 90% solvent A.

Prior to injection into the HPLC, the extract was filtered through a 4 mm, 0.2 mm nylon syringe filter (Alltech, Deerfield, Illinois). After filtering 200 µL extract was injected into the HPLC. The detector was optimized at 270 nm for β-carotene and lutein, and 290 nm for α-tocopherol. The peaks were identified with standards lutein (X6250), β-carotene (C4582), α-tocopherol (T3251), and α-tocopherol acetate (T3376) purchased from Sigma Chemical Co. (St. Louis, Missouri) and confirmed by LC/MS.

Mass Spectrometry

Mass spectra were monitored in the mass range m/z 300–700 on a Quattro II mass spectrometer equipped with an atmospheric pressure chemical ionization (APCI) interface (Micromass, Beverly, Massachusettes). The capillary temperature was set to 150°C, the APCI vaporizer temperature was set to 450°C. The corona discharge voltage was optimized at 3 kV. The same column and LC conditions used in the HPLC-UV diode array experiments were also used for the LC-MS experiments, however the flow rate was reduced to 0.3 mL min^{-1}.

RESULTS

Lutein

The fresh curry leaves had the highest concentration of lutein and the frozen leaves had the lowest concentration of lutein (Table 1). Frozen curry leaves contained 70% less lutein than fresh leaves. Curry leaves subjected to oven-drying and air-drying contained 60% less lutein compared to fresh leaves.

α-Tocopherol

The α-tocopherol concentrations of the fresh leaves were unaffected by freezing at –15°C (Table 1). Air-drying at 22°C resulted in a lower loss of α-tocopherol (13%) compared to oven-drying where 50% of α-tocopherol was lost.

Table 1. Anti-oxidant vitamin contents in curry leaves and post harvest storage temperature and treatment (mean concentration per gram dry weight±SD).

Post harvest storage temperature and treatment	Lutein (µg/g)	α-tocopherol (ng/g)	β-carotene (ng/g)	Chlorophyll (mg/g)
Fresh	27±2.8	592±10.1	511±10.5	27.8±1.2
Oven-dried (60°C)	11±1.9	296±8.2	148±1.2	9.9±1.2
Air-dried (22°C)	10±2.1	515±8.5	357±1.3	18.9±1.1
Frozen (–15°C)	8±2.5	589±11.2	398±1.5	26.9±1.1

β-Carotene

The β-carotene concentration was highest in fresh leaves and lowest in the oven-dried leaves (Table 1). The loss of β-carotene were 22% in frozen, 30% in air-dried, and 71% in oven-dried samples.

Chlorophyll

The fresh and the frozen curry leaves had similar chlorophyll concentrations (Table 1). Oven-drying resulted in a greater loss (~64%) of chlorophyll compared to air-drying (~32%).

DISCUSSION

Our results report a lower loss of β-carotene and apparently no loss of α-tocopherol and chlorophyll concentration in curry leaf frozen at –15°C compared to air-drying or oven-drying. However, the loss of lutein in the frozen samples was higher perhaps due to destruction of lutein during the freezing process. The loss of β-carotene, α-tocopherol, and chlorophyll when air-dried or oven-dried may be attributed to loss of these compounds due to oxidation. Our results identify freezing at –15°C as an acceptable practical way of storing curry leaves. Air-drying resulted in higher retention of vitamins β-carotene and α-tocopherol compared to oven-drying.

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