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EFFECT OF THREE DRYING METHODS ON ANTIOXIDANT EFFICIENCY AND VITAMIN C CONTENT OF MORINGA OLEIFERA LEAF EXTRACT

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1 INTRODUCTION

Moringa oleifera leaves have been reported to be a good source of natural antioxidants, such as ascorbic acid, carotenoids, flavonoids and phenolic compounds and the highest amount of vitamin C within the plant is concentrated in the fresh leaves [1,2].

The concentrated leaf extract of Moringa oleifera might be a useful source of nutrients for several processes in food industry; however, extraction and drying operation conditions may damage many of the nutritional constituents from the raw material.

In this work, three drying methods: convective, vacuum and freeze-drying, were used to study the effect of different conditions of drying temperature and pressure on vitamin C content and antioxidant efficiency of the extract of Moringa oleifera leaves.

2 METHODOLOGY

Moringa oleifera nutrients from leaves have been extracted with several processes, the most common involves solid-liquid extraction with a mixture ethanol-water followed by evaporation and a drying process [3].

a) Plant Material

Moringa oleifera leaves were collected from several trees grown within the National University of Engineering, Managua, Nicaragua. Leaves, excluding petioles, were washed with distilled water and drained for experimentation.

b) Experimental Apparatus

Solid-liquid extraction of leaves was carried-out in a Julabo® Shaking Water Bath model SW-23. For convective drying at normal pressure, a Fisher Scientific™ Isotemp™ model 825F oven was used. Vacuum drying was carried-out in a Büchi Rotavapor model R-124 connected with a Büchi Vac® model V-500 Vacuum Pump.

For the freeze-drying process, a Labconco Freezone Console 12 L Freeze Dry System along with a Labconco Rotary Vane Vacuum Pump with a 195 L/min capacity, were used.

Determination of vitamin C content was carried-out using High-Pressure Liquid Chromatography (HPLC) in a KONIK® HPLC 560 System, while a Hach® DR 5000™ UV-Vis Laboratory Spectrophotometer was used to measure absorbance for the free radical inhibition method, employing DPPH at 517 nm to determine antioxidant efficiency.

c) Antioxidant Efficiency Assay

To evaluate the antioxidant efficiency of the samples, a procedure based on the methodology described by Sánchez-Moreno et al. [4] was employed. A 0.0250 g/L solution of DPPH$^{\cdot}$ (2,2-diphenyl-1-picrylhydrazyl) in ethanol absolute was prepared daily for analysis.

A calibration curve of DPPH concentration against absorbance was carried-out to calculate DPPH concentration in reaction medium.

$$A_{517\,nm} = 62 \times [DPPH^{\bullet}]_t + 0.0122 \qquad (1)$$

Antioxidant Efficiency (AE) defined by [4] was calculated with the equation:

$$AE = 1/(EC_{50} \times t_{EC_{50}}) \qquad (2)$$

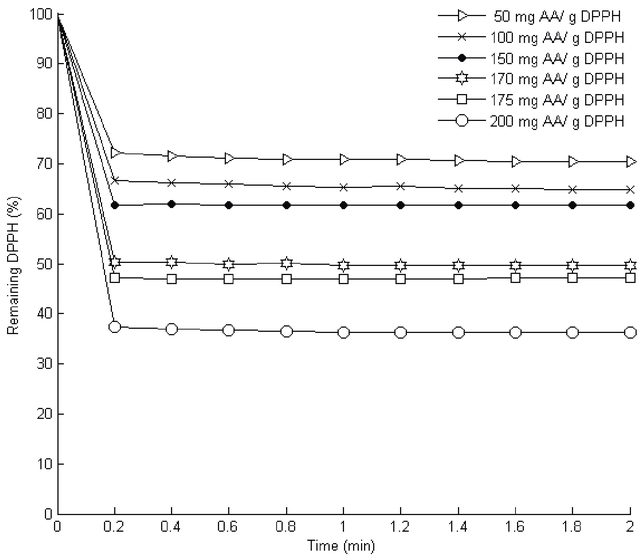

Fig. 1 Kinetic plot for DPPH$^{\cdot}$ free radical scavenging activity of ascorbic acid standard.

3 RESULTS AND DISCUSSION

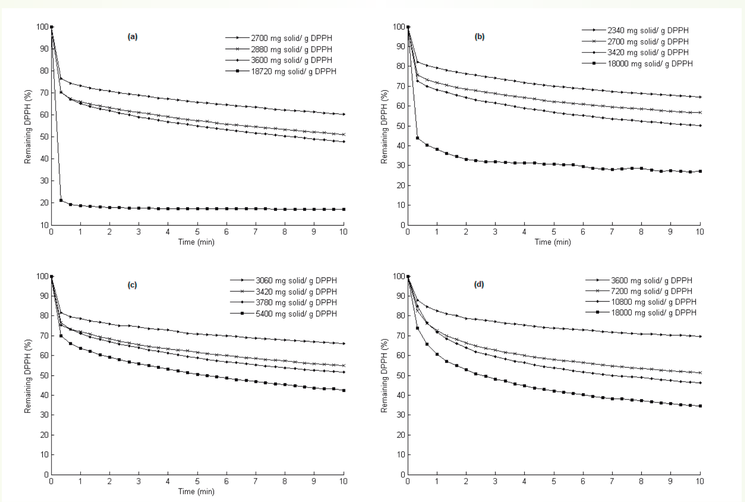

Fig. 2 Kinetic plots for determination of EC_{50} and tEC_{50} values. a) Leaves extract (LE), b) Freeze-dried extract (FD), c) Vacuum dried extract (VE) and d) Convective

TABLE I
ESTIMATED DPPH$^{\cdot}$ ASSAY PARAMETERS

Sample	EC_{50} ($mg\ solid\ g^{-1}\ DPPH^{\cdot}$)[a]	$t_{EC_{50}}$ (min)[a]	AE ($g\ DPPH^{\cdot}\ mg^{-1}\ solid \cdot min^{-1}$)	Kinetic Classification[b]	AE Classification[b]	AE Degradation[c]
Vitamin C	169.38 ± 6.4	1.0 ± 0.1	5.903 E-3	Rapid	High	-
LE	2902.5 ± 14.8	11.8 ± 0.5	2.920 E-5	Intermediate	Low	-
FD	3433.1 ± 85.2	10.1 ± 0.3	2.884 E-5	Intermediate	Low	1.2 %
VE	3980.1 ± 37.2	10.0 ± 0.2	2.512 E-5	Intermediate	Low	14.0 %
CO	8123.5 ± 263.3	12.2 ± 0.8	1.009 E-5	Intermediate	Low	65.4 %

[a]Each value is the mean ± standard deviation. bClassification according to [2]. cCalculated considering leaves extract (LE) as reference. Values with the sam e letter (A, B, C) are not significantly different ($p < 0.05$), between samples.

TABLE II
RESULTS OF ASCORBIC ACID CONTENT

Sample	Ascorbic acid (mg/L)	Degradation Percentage[a]	Drying Process Affectation[b]
LE	59.0 ± 0.3	-	-
FD	49.7 ± 0.6	15.8 %	Low
VE	45.0 ± 0.4	23.7 %	Moderate low
CO	23.6 ± 0.7	60.0 %	High

[a]Calculated considering leaves extract (LE) as reference. bConsidering reported degradation values of vegetables after drying process at several temperatures [5]. All values were significantly different ($p < 0.05$), between samples.

4 CONCLUSIONS

The different drying conditions inherent to the three drying methods (temperature, pressure and time) were found to have a considerable effect on the ascorbic acid and antioxidant efficiency degradation.

The convective drying at 100°C, normal pressure and eight hours damaged significantly the ascorbic acid and antioxidant efficiency compared to the leaves lixiviate.

The most effective method for conservation of both parameters was freeze-drying with a remarkable conservation of antioxidant efficiency compared to other methods.

Nevertheless, the vacuum drying method showed a good performance in conservation of vitamin C and antioxidant efficiency and is also recommended for industrial processing of Moringa leaves extracts.

5 REFERENCES

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