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The Effect of Drying Method on the Nutrients and Non-nutrients Composition of Leaves of *Gynandropsis gynandra* (Capparaceae)

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Abstract: The effect of solar, sun and oven drying on the nutrients and non-nutrients composition of leaves of *Gynandropsis gynandra* was determined. Ash content of sun (3.14±0.09%), solar (3.16±0.03%) and oven (3.30±0.08%) dried samples were significantly (p<0.05) increased compared to fresh samples. All the drying methods were found to significantly (p<0.05) lower moisture, carbohydrates and protein. However, crude fibre content was significantly (p<0.05) increased with drying method. Drying method, with exception of oven drying, did not significantly (p>0.05) lower lipid content. Significant (p<0.05) increases of mineral elements upon drying with exception of sodium were observed. Alkaloids, tannins, saponins, saponins glycosides, flavonoids and volatile oils were detected in fresh and dried samples. These phytochemicals detected were found to decrease upon drying to trace amounts. Solar and oven drying were found to significantly reduce acid value from 3.91±0.31 to 1.66±0.06 and 2.69±0.33%, respectively. Solar drying may be the preferred method of drying the leaves of *Gynandropsis gynandra* as it is faster, more hygienic and preserves the nutrients better.

Key words: Drying method, *Gynandropsis gynandra*, nutrients, non-nutrients

INTRODUCTION

An important challenge to ensuring food security in most developing societies is making food available all year round. Most agricultural products are perishable and are abundant at a particular season but absent at other seasons (Habou *et al.*, 2003). Agricultural products tend to become scarce in other seasons making food preservation an important activity in households and communities. Drying as a form of processing ensures the availability of perishable products all year round (Habou *et al.*, 2003). Drying method is used in Nigeria for preserving leafy vegetables and example of such vegetables is leaf of *Gynandropsis gynandra*. Drying leafy vegetables increases their shelf life upon storage (Eklou *et al.*, 2006). The need for well established data on the nutrients and non-nutrients composition of food is of great importance in identifying and solving nutritional problems in the society.

Drying agricultural produce by sun drying is widely used in most of the developing countries of the tropical region. However, solar drying is an elaboration of sun drying and was the most hygienic method of drying (Bala and Woods, 1994). The leaves of *Gynandropsis gynandra* are preserved traditionally using sun drying (open air) and this is associated with possible contamination by microorganisms, infestation by insects and rodents. Their quality can be diminished and even become inedible (Diamante and Munro, 1993).

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Gynandropsis gynandra (family Cappraceae) is commonly called cat whiskers, African spider flower and bastard mustard. It is widely distributed in Africa and it is found growing abundantly during rainy season as a wild uncultivated green leaf in many parts of northern Nigeria. It is a vegetable with five foliate leaves and white flowers. Some ethnic groups in Africa boil sun dried leaves of the plant and store them in a well ventilated place (Cheweya, 1995). In Nigeria and East Africa, the leaves are used as ingredient in other mashed food. The dried leaves are grounded, incorporated in weaning food and are combined with other ingredient in a soup. They are leafy vegetables that provide nutrients to the body. The leaves have higher percentage of vitamin C and are taken as a pot herb in soups, fresh or dried and it has also alkaloids, cyanogenic glycosides, anthraquinones and steroidal nucleus (Ajaiyeoba, 2000).

Despite the widespread use of *Gynandropsis gynandra* information is lacking on the effect of preservation methods on its nutrient and non-nutrient contents and the best method for its preservation. This study therefore aimed at comparing the effects of traditional sun drying with other drying methods on the nutrient and non-nutrient composition of leaves of *Gynandropsis gynandra* using fresh sample for comparison.

MATERIALS AND METHODS

Chemicals

All chemicals used were of analytical grade.

Collection of Plant

Gynandropsis gynandra was obtained from the campus of Usmanu Danfodiyo University Sokoto, Nigeria. It was authenticated at the Herbarium, Department of Biological Sciences (Botany Unit) of the same institution. Voucher specimen was deposited in the Herbarium for reference. The research was done at Department of Biochemistry, Usmanu Danfodiyo University, Sokoto, Nigeria, from July to August 2006.

Plant Preparation

The leaves collected were washed with water to remove dust and some portion was dried to a constant weight using the three drying methods. Fresh samples of the leaves were used as control.

Sun Drying

The leaves were kept under the sun (ambient temperature 35-41°C) in June 2006, between 10.30 am - 5.30 pm daily till the leaves attained constant weight.

Solar Drying

A solar dryer designed by the Sokoto Energy Research Center, Usmanu Danfodiyo University Sokoto, Nigeria, was used as dryer for the sample. The dryer is a combine direct and indirect rocked thermal storage passive cabinet dryer. The dryer stores heat in rock bed, a device intended to overcome temperature fluctuations during sun set hours. The temperature of the drying chamber ranged between 42 and 63°C while that of the solar dryer of the leaves collector was between 40 and 73°C. Solar drying of the samples took place between 10.30 am - 5.30 pm daily till the sample attained a constant weight (Matazu and Haroun, 2004).

Oven Drying

The leaves were oven dried (60°C) using hot air oven (Stuart Scientific, England) for 24 h to obtain a completely dried sample.

Nutrients and Non-nutrients

The dried and fresh leaves were analyzed for moisture content using the method of Oyeleke (1984) and crude protein content by modified Kjeldahl method. The method of Yawas and Obi (2001) was employed in the analysis of carbohydrates. Ash content was determined by the method of Samuel *et al.* (1997). Crude lipid and fibre contents were determined by the procedures of Association of Official Analytical Chemists (AOAC, 1980). Acid value was determined by the method of Chopra and Kanwar (1991). Phytochemical screening was done using standard procedures of Wall *et al.* (1954), Persinos and Quimby (1967), Harbone (1973), Trease and Evans (1978) and El-Olemyl *et al.* (1994).

Statistical Analysis

Values are presented as means±standard deviations. Analysis of variance, complete randomized design, statistical analytical system (1988), SAS/STAT user's guide release (6, 035. A. Cary, N.C., USA) was used to analyze the data. A least significant difference (LSD) at 5% probability was considered significant.

RESULTS

The results of proximate analysis, mineral elements and phytochemical compositions of fresh and dried leaves of *Gynandropsis gynandra* are presented in Table 1, 2 and 3, respectively. Ambient temperature during drying was 35-41°C (mean 38°C). The time taken for the leaves to attain constant weight was 25, 9 and 17 h for sun, oven and solar drying, respectively. Solar and sun drying was done for a period of 4 and 5 days, respectively, because of interruption of rainfall.

Moisture, carbohydrate and protein contents were significantly ($p<0.05$) lower in all the drying methods (Table 1 and 2) compared to fresh sample. Mineral elements with exception of sodium were significantly increased upon drying. Calcium and potassium on the other hand were higher in sun dried (0.27 ± 0.02 mg/100 g) followed by oven dried (0.12 ± 0.02 mg/100 g) and solar dried samples (0.12 ± 0.01 mg/100 g). Ash and crude fibre content were significantly ($p<0.05$) increased in all the drying methods compared to fresh sample. Solar ($7.23\pm0.09\%$) and sun ($6.68\pm0.026\%$) drying did not significantly lower lipid content.

Phytochemicals detected in the leaves of *Gynandropsis gynandra* (Table 3) were decreased with drying methods because of heat upon processing. Solar and oven drying significantly reduced acid value from 3.91 ± 0.31 to 1.66 ± 0.06 and 2.69 ± 0.03 , respectively.

Table 1: Proximate composition of fresh and dry leaves of *Gynandropsis gynandra*

Drying method	Protein (%)	Carbohydrate (%)	Ash (%)	Fibre (%)	Lipid (%)
Fresh	18.58±0.51 ^d	67.78±1.90 ^a	2.36±0.21 ^b	2.36±0.22 ^b	7.98±0.22 ^d
Oven	13.08±0.83 ^b	43.23±2.10 ^d	3.30±0.08 ^a	6.00±1.63 ^a	4.55±0.21 ^c
Sun	14.30±0.29 ^c	53.80±2.66 ^c	3.14±0.09 ^a	6.33±0.17 ^a	6.68±0.26 ^d
Solar	14.10±0.27 ^a	51.15±0.87 ^b	3.16±0.03 ^a	5.60±0.24 ^a	7.23±0.09 ^d

Values are means±standard deviation. Means with the same letter(s) on the same row are not significantly different using the method of least significant difference (LSD) at 5% probability

Table 2: Moisture and mineral element composition of fresh and dried leaves of *Gynandropsis gynandra*

Drying method	Moisture (%)	Ca ²⁺ (mg/100 g)	Mg ²⁺ (mg/100 g)	Na ⁺ (mg/100 g)	K ⁺ (mg/100 g)
Fresh	90.00±4.89 ^a	0.06±0.01 ^c	0.17±0.03 ^c	8.04±0.02 ^d	0.23±0.05 ^d
Oven	55.80±1.72 ^c	0.12±0.02 ^b	0.84±0.02 ^a	6.24±0.07 ^a	1.17±0.06 ^c
Sun	63.75±4.50 ^b	0.27±0.02 ^a	0.55±0.04 ^d	4.03±0.04 ^b	1.28±0.07 ^b
Solar	60.75±0.96 ^b	0.12±0.01 ^b	0.38±0.01 ^b	5.62±0.49 ^c	1.42±0.06 ^c

Values are means±standard deviation. Means with the same letter(s) on the same row are not significantly different using the least significant difference (LSD) at 5% probability

Table 3: Phytochemical screening of fresh and dried leaves extracts of *Gynandropsis gynandra*

Phytochemicals	Drying method			
	Fresh	Oven	Sun	Solar
Alkaloids	+++	+	+	+
Tannins	+++	+	-	+
Saponins	+++	+	+	+
Flavonoids	+++	+	+	+
Saponin glycosides	+++	+	+	+
Volatile oils	+++	+	-	+
Cyanogenic glycosides	-	-	-	-

+++ = Presence, ++ = Presence in trace amount, - = Absence

DISCUSSION

Removal of moisture by heat generally improves the digestibility of foods, increases concentration of nutrients and can make some nutrients more available (Morris *et al.*, 2004). Moisture content of fruits and vegetables provide an enabling environment for growth of microorganisms, thus, it has to be reduced if vegetables and fruits are to be preserved or kept for long time to be used and this may inhibit autolytic enzymes (Ladan *et al.*, 1997).

The significant decrease of macronutrients upon drying may be attributed to the stability of the bonds involved in them. The intensity of heat applied due to efficiency of the dryers was found to be commensurate with the decrease in protein content. Morris *et al.* (2004) reported losses of these macronutrients especially protein due to application of heat. It is clear from this work that macronutrients value decreases when dried under heat. The results tallied with the assertion of Ladan *et al.* (1997) that heat reduces the nutrient value of tomatoes.

However, higher potassium with low sodium from the result is a protective effect against excessive sodium intake. The high potassium level in the dried samples may be an added advantage over the fresh sample for use as a therapy and are vital for bone (Dzomeku *et al.*, 2006). The results from this study indicated that mineral element composition of *Gynandropsis gynandra* vary with drying method. There is no known explanation regarding this unusual observation. However, it may be due to environmental, genetic factors and the method of analysis employed. The higher ash content of sun followed by solar and oven dried samples (having the lowest) may indicate higher mineral elemental composition of leaves of *Gynandropsis gynandra*. The decrease of phytochemicals upon drying may increase the bioavailability of micronutrients such as calcium and magnesium to the body. Natural non-nutrients in foodstuffs are known to be destroyed by heat during processing (Matazu and Haroun, 2004). In general, the observed increases or decreases in the nutrients and non-nutrients components of dried samples may be attributable to the lost of water molecules.

From present results, the leaves of *Gynandropsis gynandra* have valuable nutrients in fresh and dried sample with reduction of some non-nutrients upon drying. Solar drying may be the preferred method of drying the leaves of *Gynandropsis gynandra* as it is faster, more hygienic and has better nutrients preservation capability. Therefore, solar drying may ensure the availability of *Gynandropsis gynandra* in good form all year round. Micronutrients and macronutrients from other sources should be used to complement lost nutrients during drying.

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