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Influence of drying methods on the proximate and phytochemical composition of *Moringa oleifera* lam.

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ABSTRACT

This study was aimed at investigating the influence of different drying methods on the proximate and phytochemical composition of *Moringa oleifera*. Fresh samples of *Moringa* leaves were collected, sorted, dried using three different drying methods viz; air drying, oven drying and sun drying methods. The already dried plant samples were ground using clean laboratory blender separately. The powdered plant samples were analysed separately for their phytochemical constituents using appropriate methods. They were also subjected to proximate analysis. The dry matter, crude protein, crude fibre, carbohydrate composition as well as ash content of the plant showed significant differences across the drying methods at $p < 0.05$. From the results, there was variation in the composition in respect of the phytochemical in question but it could be concluded that, all the drying methods have little effect on the phytochemical composition of the studied plant but air drying methods could be adopted as it gave high energy and carbohydrate content.

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INTRODUCTION

Moringa oleifera Lam. is a short, slender and perennial tree belonging to the Moringaceae family. It is widely cultivated and naturalized in tropical India, Africa, tropical America, Sri Lanka, Mexico, Malaysia and the Phillipine Islands (Sabale, 2008). *Moringa oleifera* is a small, fast-growing evergreen or deciduous tree that usually grow up to 10 to 12m in its height, open crown of drooping fragile branches, feathery foliage of trip innate leaves and thick corky, whitish bark (Roloff *et al.*, 2009). The *Moringa* tree is a multi-functional plant. It has been cultivated in tropical regions all over the world for its nutritional quality for animals and humans, high oil contents of the seeds and waste water treatments (Foidl *et al.*, 2001). The *Moringa* tree is cultivated and the various plant parts such as leaves, pods, flowers, roasted seeds are used as vegetables, roots mainly for spice, seeds for cooking and cosmetics oil; all plant organs are used in medicine (Rebecca *et al.*, 2006).

In humans, many phytochemicals have been found to be protective and preventive against many degenerative diseases and pathological processes such as ageing (Burns *et al.*, 2001). *Moringa* leaves contains phytochemical having potent anticancer and hypotensive activity and are considered full of medicinal properties and used in siddha medicine (Monica *et al.*, 2010). *Moringa* leaf is known to be beneficial for people with cardiovascular disorders. The leaves have been reported to have hypocholesterolaemic property (Ghasi *et al.*, 2000), and is known to be helpful for people with diabetes mellitus (Kar *et al.*, 2003).

Its leaf juice is also known to have a stabilizing effect on blood pressure. *Moringa oleifera* has been reported to contain various phytochemicals and micronutrient which are beneficial to human for consumption. Nutritive and non-nutritive phytochemicals have been reported in this plant (Ijeomah *et al.*, 2012).

The leaves of this plant are used as vegetables in soup preparation or cooked and mixed with grounded groundnut cake and other spices, and then eaten as food (Kawo *et al.*, 2009). The locals in using *Moringa* leaves both as vegetable and curing ailments employ different methods of preparation. When not freshly used, many times, drying is usually employed to preserve the parts for later use or any other reasons. The dried *Moringa* like most drug plants and vegetables that are perishable are normal phenomenon in open markets found in most West African countries where they are sold (Mensah *et al.*, 2012). The source and quality of raw materials, good agricultural practices and manufacturing processes are crucial steps for the quality control of herbal medicines and play a pivotal role in guaranteeing the quality and stability of herbal preparations (WHO, 1988; 1992; 1998; 2000; 2003; 2004; Roberts *et al.*, 1997; Blumeathal *et al.*, 1998; and EMEA, 2002). Drying is one of the major

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processes involved in the preparation of drug plants. Similarly, scientists have used dried materials for the extraction of biologically active compounds. This is important since during drying, membranes of plant organelles containing different secondary compounds are destroyed, making extraction more efficient (Iqbal *et al.*, 2006). Labile compounds may, however, be destroyed during the drying process or if hydrolase enzymes released when vacuolar membranes are broken during the drying process (Iqbal *et al.*, 2006)

Plants can be dried in a number of ways: in the open air (shaded from direct sunlight); placed in thin layers on drying frames, wire-screened rooms, or in buildings; by direct sunlight, if appropriate; in drying ovens/rooms and solar dryers; by indirect fire; baking; lyophilization; microwave; or infrared devices.

In reference to the reported importance of this plant due to the presence of many phytochemicals and drying techniques reported above, this study thus aimed at investigating the influence of different drying methods on the proximate and phytochemical composition of *Moringa oleifera*.

MATERIALS AND METHODS

Collection and Identification of Plant Samples:

Fresh and healthy plant materials were used for this study. The plant samples were collected in Tanke area, along University of Ilorin road, Ilorin, Nigeria. The plants were then taken to the University of Ilorin herbarium for identification and authentication. The voucher specimen was subsequently dropped in the herbarium for reference purpose.

Processing of Plant Materials:

Sorting:

Fresh, green, undamaged, non-insect infested leaves were selected while the bruised, discoloured, decayed and wilted leaves were discarded before washing the leaves.

Washing:

The stalks of the leaves were cut from the main branches and the leaves were washed thoroughly three times with plenty of water to remove all the adhering dust, dirt and particles. The sample was then divided into three batches for the drying methods.

Drying methods:

Three drying methods which are Oven drying, Shade drying and sun drying were employed in this study.

Oven Drying:

The leaves were loaded in the tray for drying using hot air. The oven was pre-heated to 60°C and this temperature was maintained for one hour for the leaves to dry. The leaves were dried for four hours until it was completely dried. Then it was properly labelled and stored in a transparent cellophane bag.

Air Drying:

The leaves were spread on cotton sheet and kept in well ventilated room at a room temperature for three weeks.

Sun Drying:

The leaves were spread on cotton sheet and then covered with netted cloth to keep off insects and dust. The cotton sheet was now placed in direct sunlight away from animals and turned occasionally to ensure even drying. The leaves were sun-dried for five days. It was then labelled and stored for further analysis.

Proximate Analysis of Plant Samples

The proximate analysis of the powdered plant samples for protein, fat, fibre, ash and dry matter was determined using the methods described by AOAC (2000) at the Department of Chemistry, Faculty of Science, University of Ilorin.

Phytochemical Screening:

Qualitative and quantitative phytochemical screenings were carried out on the powdered plant constituent separately using well established protocols (Harbone, 1973; Boham and Kocipal-Abyaza, 1994);

Statistical Analysis:

Data generated from the proximate and phytochemical analysis were subjected to ANOVA so as to compare the mean value using SPSS. Differences between means were assessed for significance at $p < 0.05$ using Least Significant Differences (LSD).

RESULTS AND DISCUSSION

Effect of drying methods on the proximate analysis

The proximate composition of *Moringa oleifera* dried using different drying methods revealed variations in the composition. The dry matter composition of the plant revealed that there was significant difference among them; the plant dried under shade had higher dry matter (97.633 ± 0.188), while the plant dried under sun had the lowest dry matter (94.503 ± 0.072) (Table 1). Though there were differences between the drying methods (Table 1), the fatty acid and crude fat content of the test samples revealed that there were no significant differences between their contents in respect to drying methods. The energy value of the sample dried under shade was higher (1420.1 ± 9.998) numerically but statistically the same at $P < 0.05$ (Table 1). Higher crude fibre of 9.003 ± 0.526 was also recorded in the sun-dried sample which makes the sample significantly lower than the treatment (Table 1). The crude protein, moisture and carbohydrate were significantly different among the drying methods with sun-dried sample recording the highest composition in protein and moisture content, but air-dried sample had the highest carbohydrate (Table 1). There were also significant differences in the ash content of the samples dried under different methods and air-dried method recorded low ash content (Table 1).

The leaf of dried *Moringa* leaf is rich in nutrients with high energy value, dry matter and protein, and moderate carbohydrate. In most developing countries where the bulk of meals are basically starches, foodstuffs rich in protein are necessary and recommended to meet the daily protein requirements. In most cases, the fresh leaf is used as vegetables in soups or the dried leaf powder is used as nutrient supplement for managing the protein deficient disease in infants generally referred to as Kwashiorkor in West Africa.

The carbohydrate content (72.98 mg/g) of air-dried *Moringa* leaves in this study is higher than $41.2 \text{ mg}/100 \text{ g}$ reported by Mensah *et al.* (2012) even with the use of the same method. This may be due to different location of collection. Carbohydrates contribute to fat metabolism and spare proteins as energy source for human beings (Gordon, 2000; Gaman and Shenington, 1996) as cited by Mbah *et al.*, (2012).

Though, the low fat and fibre contents reported here are in agreement with the result obtained by Subadra and Monica (1997), however, the fibre content reported by Mensah *et al.* (2012) using shade drying method was three times better than the value observed in the present study when same method was employed. Fibre has been reported to cleanse digestive tract by removing potential carcinogens from the body and hence prevents the absorption of excess cholesterol (Lisa, 1997). In addition, fibre adds bulk to food and reduces the intake of excess starchy food which is the characteristic of the diet of the poor and locals and hence guard against metabolic conditions such as hypertension and diabetes mellitus.

The low moisture and ash contents reported here are in agreement with Mba *et al.* (2012) where similar methods of drying were employed. Low moisture content is always desirable for higher stability of drugs and high ash content is an indication of contamination or adulteration (Krishna and Singh, 2012).

Table 1: Proximate Composition of *Moringa oleifera* using different drying methods.

| Parameters | DRYING METHODS | | |
|------------------|-------------------------|----------------------|----------------------|
| | Oven Drying (mg/g) | Shade Drying (mg/g) | Sun Drying (mg/g) |
| Dry Matter | $96.803 \pm 0.003^{b*}$ | 97.633 ± 0.188^a | 94.503 ± 0.072^c |
| Fatty Acids | 1.643 ± 0.012^a | 1.617 ± 0.012^a | 1.636 ± 0.009^a |
| Energy Value | 1413.8 ± 8.565^a | 1420.1 ± 9.998^a | 1416.9 ± 3.385^a |
| Crude Protein | 15.837 ± 0.203^a | 11.747 ± 0.415^b | 22.523 ± 0.355^c |
| Crude Fibre | 6.993 ± 0.073^b | 6.790 ± 0.361^b | 9.003 ± 0.526^a |
| Crude fat | 1.937 ± 0.059^a | 1.177 ± 0.043^a | 1.473 ± 0.453^a |
| Ash Content | 7.163 ± 0.024^a | 4.943 ± 0.038^b | 7.000 ± 0.700^a |
| Moisture Content | 3.197 ± 0.003^b | 2.367 ± 0.188^c | 5.487 ± 0.057^a |
| Carbohydrate | 64.873 ± 0.180^b | 72.977 ± 0.549^a | 54.183 ± 0.896^c |

Values are means of 3 readings \pm Standard Error of Mean

Means with similar indices in each row are not significant ($P \leq 0.05$)

Effect of drying methods on the phytochemical analysis:

Moringa oleifera like other medicinal plants contains various phytochemicals which are responsible for the much touted medicinal application of the species. The phytochemical analysis of plant species not only showed the presence of these compounds but also revealed a variation in the concentration of such compounds as alkaloids, flavonoids, phenolics, saponins, and tannins using different drying methods. Irrespective of the drying method, the highest concentration was observed in phenols followed by saponins then alkaloids and then flavonoids with tannins having the lowest value in the studied species. Although, the phenolic content was found to be significantly different for the diverse drying methods employed, no significant difference was observed in other phytochemicals tested. However, the phytochemicals were different numerically but were found to be statistically different (Table 2).

With reference to Table 2, the alkaloids and phenols recorded their highest value when samples were oven dried ($1.437 \pm 0.012 \text{ mg/g}$ and $2.057 \pm 0.027 \text{ mg/g}$ respectively) while flavonoids were found to be more when

samples were sun dried (1.043 ± 0.009 mg/g) against 1.03 mg/g observed using oven dried and shade drying methods.

Mbah *et al.*, (2012) in comparing the anti-nutrient or phytochemical composition of *Moringa oleifera* collected from two different areas in the Eastern part of Nigeria, tannin was found to increase in the dried samples while saponin content decreased compared to the same in the fresh samples. 1.37 - 1.84 mg/g, 1.25 - 1.56 mg/g and 1.60 - 1.62 mg/g were the values reported for tannins when samples were sun dried, oven dried and shade dried respectively. Saponin, according to their result had 0.31 - 0.33 mg/g for sun dried samples, oven dried sample contained 0.49 mg/g saponins while samples dried under the shade had between 0.83 mg/g and 0.84 mg/g saponin.

The result in this present study also confirmed the above. However, the slight differences observed might not be unconnected to the difference in geographical locations owing to different climatic and edaphic factors (Mbah *et al.*, 2012). Although, the same species of the plant under study when oven dried at 55°C as reported by Ijeoma *et al.*, (2012), had alkaloids which were 28 times and flavonoids, 4 times more than those observed in this present study. This wide difference could be as a result of difference in temperature of the equipment (oven).

Generally, the phytochemical constituents decrease in value from those reported in the fresh leaves of *Moringa oleifera* irrespective of the drying method explored (Mbah *et al.*, 2012). Similarly Shilpi *et al.* (2010) reported a decrease in phytochemical content of edible Irish brown seaweed (*Himanthalia elongate*) as the temperature increases or upon drying.

Variations in composition are sometimes due to destruction during enzymatic processes that continue for long periods from collection to marketing. To prevent this phenomenon, Iqbal *et al.* (2006) recommended that proper standardization and quality control of both the raw material and the herbal preparations should be conducted.

Apart from the impacts of drying methods on the properties discussed above, factors such as source of raw materials, collection and extraction method have far reaching effect on the proximate as well as the phytochemical components of drug plants.

Table 2: Phytochemical Composition of *Moringa oleifera* using different drying methods.

| Parameters | DRYING METHODS | | |
|------------|------------------------|---------------------|---------------------|
| | Oven Drying (mg/g) | Shade Drying (mg/g) | Sun Drying (mg/g) |
| Alkaloids | $1.437 \pm 0.012^{a*}$ | 1.433 ± 0.018^a | 1.403 ± 0.009^a |
| Flavonoids | 1.033 ± 0.009^a | 1.030 ± 0.153^a | 1.043 ± 0.009^a |
| Phenolics | 2.057 ± 0.027^a | 2.010 ± 0.006^b | 1.997 ± 0.009^a |
| Saponins | 1.613 ± 0.007^a | 1.603 ± 0.003^a | 1.613 ± 0.003^a |
| Tannins | 0.133 ± 0.003^a | 0.127 ± 0.003^a | 0.127 ± 0.009^a |

Values are means of 3 readings \pm Standard Error of Mean

Means with similar indices in each row are not significant ($P \leq 0.05$)

Conclusion:

In this study, variation in the proximate and phytochemical components of *Moringa oleifera* as influenced by the different drying techniques employed has been established. Shade drying favoured dry matter, energy value, carbohydrate while crude protein, crude fibre and moisture contents were much more when sun was called into play. The highest value for fatty acids, crude fat and ash contents were observed when samples were oven dried. *Moringa* leaves were more favoured with phytochemicals using oven drying methods.

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