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Nutrient Composition of Drumstick Leaves (*Moringa oleifera)* with Different Drying Methods

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Abstract

This research was carried out to investigate the four different drying methods *i.e.,* shade, sun, oven and tray drying on the proximate composition and some minerals of *Moringa oleifera.* The proximate analysis and some minerals were analyzed using standard analytical procedures. The study revealed that the tray drying method was observed suitable for dehydration of drumstick leaves. The results revealed that four different drying methods varied from 4.26 to 6.30 per cent, 19.86 to 25.42 g, 2.79 to 4.44g, 10.17 to 14.90g, 7.60 to 9.80g, 41.18 to 53.28g, 306 to 317 Kcal, 20.03 to 26.17mg, 86.03 to 168.30mg, 27597 to 35488.53 µg/100g for moisture, protein, fat, crude fibre, ash, carbohydrate, energy, iron, vitamin C and β - carotene. The study revealed that in tray drying method the retention of nutrients is more when compare to other processing methods and suitable for dehydration of *Moringa oleifera.*

Keywords: Oven drying, Tray drying, Shadow drying, Sun drying and *Moringa oleifera*

India is one of the largest producers of fruits and vegetables in world. It is estimated that India processes less than 1 per cent of production and about 30-35 per cent production cannot be utilized due to lack of adequate technology for processing, handling, storage and processing infrastructure. Drying is the best method to increase the shelf life of fruits and vegetables (Agbede, 2012).

Moringa oleifera is one of the most widely cultivated species of a monogeneric family, the *Moringaceae*. The tree is an origin of Indian subcontinent and has become naturalized in the tropical and subtropical areas around the world. It grows best in dry sandy or loamy soil. India is the largest producer of *Moringa* and the annual production is between 1.1 to 1.3 million tonnes of tender fruits from an area of 380 km² The leaves are highly nutritious and also the rich source of beta-carotene, vitamin C, protein and iron (Farooq *et al.,* 2012).

It is used in the treatment diarrhoea, urinary disorder and gastric ulcer due to its antibacterial and anti-inflammatory action. *Moringa* leaves help to purify the blood, lowering of blood glucose and cholesterol level. In ethno medicine, *Moringa oleifera* leaves have been used by local traditional healers in treatment of various ailments such as gastric discomfort, stomach ulcers, diarrhoea, dysentery and skin infections (Adeyemi, 2014).

In certain case of diabetes, *Moringa* can also be used to stabilize sugar levels and can stabilize arterial tension. The leaves have also been found to possess antitumour, antipyretic, antiepileptic, antinflammatory, antiulcer, antispasmodic, diuretic, antihypertensive and antioxidant properties (Bukar *et al.,* 2010).

Moringa oleifera is one of the most helpful tropical trees and is generally grown at backside of the home. It is good sources of vitamins and minerals. *Moringa oleifera* tree emphasizing its nutritional applications for humans, industrial areas and its propagation methods, as not everyone knows the enormous benefits. It has significant source of bioactive compounds *viz.,* terpenoids, alkaloids, p - cymene, eugenol, chavicol, flavonoids, saponins, allyl catechol, estragol, caryophyllene, chavibetol, cineole etc. It is recognized for its food and nutritional value, with forage, medicinal and seasoning properties, being used in culinary, fuel, and cosmetics industries and in water treatment for human consumption (Parvathi *et al*., 2015).

Moringa leaves can be used as a food for human consumption in addition to being used as feed or fodder for animals. It can be prepared in different forms for human consumption and eaten either raw or dry by animals. In the tropics, it is used as forage for livestock and in many countries as vegetables that have the potential to improve nutrition ensure food security, foster rural development and support sustainable land care (Ogbe and John, 2012). The objective of this study to investigate the four different drying methods *i.e.,* shade, sun, oven and tray drying on the proximate composition and some minerals of *Moringa oleifera.*

Materialand Methods

The drumstick leaves samples were collected from the Horticulture Department, University of Agricultural Sciences, GKVK, Bengaluru. As represented in Fig. 1 the leaves were cleaned, dried with different processing methods.

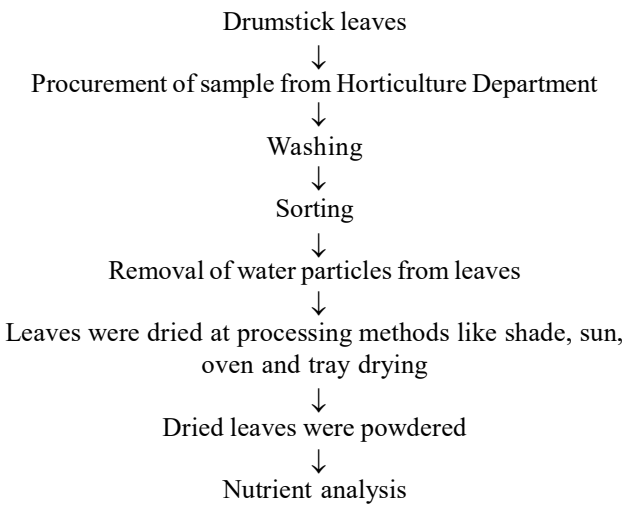

Fig. 1: Flow chart of different processing methods of drumstick methods

Shade drying: In this drying method the air dried leaves were spread on filter papers and kept in the room which was well ventilated. Natural current of air was used for 2days.

Sun drying: In sun drying method the leaves were washed and kept for air drying and then put on the filter paper. Filter paper along with tray were placed at a where adequate amount of sunlight for 10 hours.

Oven drying: The oven was preheated to 60 °C and then the single layer loaded trays were kept. The temperature was maintained at 60 °C and the process was carried out for 6 hours.

Tray drying: In tray drying method, the fresh samples were washed with sufficient amount of luke warm water till it was free from dust, rodents. The leaves were spread on the tray and placed into the cabinet tray drier at 60 °C for 3 hours.

Dried leaves were ground to fine powder passed through a 60 mm mesh sieve and stored at ambient temperature for further use in High Density Polyethylene (HDPE) food grade packing of 350 gauges.

Effect of processing methods on nutrient composition of drumstick leaves

The processed drumstick leaves samples were subjected for nutrient analysis. The nutrients analyzed were moisture, protein, fat, crude fibre, ash, iron, vitamin - c and β - carotene by AOAC methods (AOAC, 1990). Carbohydrate and energy values were computed. All determinations were done in duplicates. One way analysis of variance was applied for nutritional analysis. The statistical analysis was done by using SPSS 16 software. Significant difference was defined as $p \geq 0.05$.

Results and Discussion

Table 1 depicts, the mean score of proximate composition of different processing methods of drumstick leaves/100g.

The moisture content of the different processing methods of the dehydrated *Moringa oleifera* leaves powder was in the range of 4.26 -6.30 per cent. Maximum moisture content was in shade dried sample (6.30%) and minimum was in the tray dried sample (4.26%). The shade dried leaves had the highest moisture and relatively dried leaves obtained from tray drying method might be due to the extremely high temperature (60 ^{0}C for 3 hrs) applied at a moderately short time. This was because, during the long hours of drying, the heat was conducted from the surface to

TABLE 1

Mean score of macronutrients of different processing methods from drumstick leaves/ 100g

Processing methods / Nutrients	Moisture(g)	Protein(g)	Fat (g)	Crude Fibre(g)	Ash (g)	Carbohydrates(g)	Energy (K Cal)
Shade drying	6.30	19.86	2.79	10.17	7.60	53.28	317
Sun drying	6.14	21.55	3.35	11.10	8.10	49.75	315
Oven drying	5.53	22.40	4.30	13.23	8.89	45.65	310
Tray drying	4.26	25.42	4.44	14.90	9.80	41.18	306
SEm±	0.02	0.09	0.04	0.13	0.10	0.12	0.19
CD at 5%	0.06	0.27	0.12	0.39	0.30	0.36	0.57

the interior of the leaves and the rate of evaporation of water on the surface of the leaves was faster than the rate of diffusion to the surface. This result was consistent with the findings (Amabye *et al.,* 2016).

The protein content of different processing methods of the dehydrated leaves was in the range of 19.86-25.42g. Maximum protein content was in the cabinet tray - dried sample (25.42 g) and minimum protein contained was recorded in the sun dried sample (19.86 g). The protein content was maximum in tray drying process due to themoisture loss (Foline *et al.,* 2011).

The fat content of different processing methods of the dehydrated leaves was in the range of 2.79-4.44 per cent. The fat content was highest in the tray dried samples (4.44) and lowest in the shade dried sample (2.79). In dehydrated leaves has higher amount of fat content as compared to the fresh one was reported by Aremu (2014).

The fibre content of the tray dried sample was highest in (14.90g) and the lowest was recorded in shade dried sample (10.17g). The highest fibre content was found more tray dried sample this may be due to the concentrated nutrient accumulated due to the loss of moisture.

The results showed that ash contents in tray dried sample were significantly higher when compared to the other processing methods. Ash content of dehydrated leaves was in the range of 7.60-9.80g.

Carbohydrate content of different processing methods of the dehydrated leaves was in the range of 41.18-53.28 g. The carbohydrate content in the dehydrated powder of shade dried sample was maximum (53.28g) and minimum was recorded in the tray dried sample (41.18g). Tray dried leaves relatively lost more carbohydrates than all the other drying methods because during the heating, the starch was turned to dextrin which drove off the water, whilst the sugar caramelised quickly and then burnt carbohydrates, which are usually lost during heating Satwase (2010).

The Energy content of processing methods of drum stick leaves ranges between 306 to 317 Kcal. The highest energy was found in shade drying (317 Kcal) and lowest in tray drying (306). It is due to the concentration effect through the removal of water content in drumstick leaves. The present study is on par with the studied conducted by the Aremu and Akintola (2014).

Fig. 2 represents the iron content of shade drying was 20.03g, sun drying 22.66g, oven drying 24.33g and tray drying 26.17/100g. The iron content was found to be more in tray dried sample it may be due to the concentration increased in total ash content.

Fig. 3 depicts the vitamin C content of different processing methods was 100.53, 86.03, 168.30, 133.16 mg/100g for shade drying, sun drying, oven drying and tray drying. The vitamin C content was highest in shade drying and lowest in tray drying. It may be due to the vitamin C and a heat labile and is destroyed when exposed to direct sunlight and heat due to oxidation.

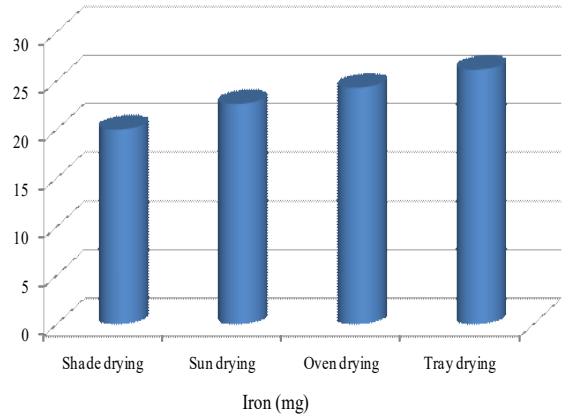

Fig. 2 : Iron content of different processing methods of drumstick leaves

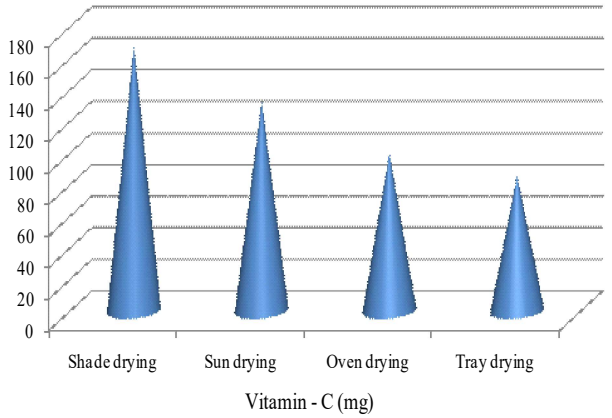

Fig. 3: Vitamin C content of different processing methods of drumstick leaves

The present study is on par with the study conducted by the Joshi and Mehta (2010).

Fig. 4 represents the beta carotene content for shade drying, sun drying, oven drying, tray drying were 32.570, 67.275, 97.30, 35488.53 and 30146.57 µg/100g. The β carotene content is highest in shade drying and lowest in tray drying and it is due to the shade drying though took longer than sun, tray and oven drying carotene losses were lowest in the shade dried sample and it is dependent on the method of drying.

From the results of the present study, it can be concluded that the different processing methods of *Moringa oleifera* was found to be having all the nutrients in good amounts and possess good nutritive value interims both micro and macro minerals. Tray

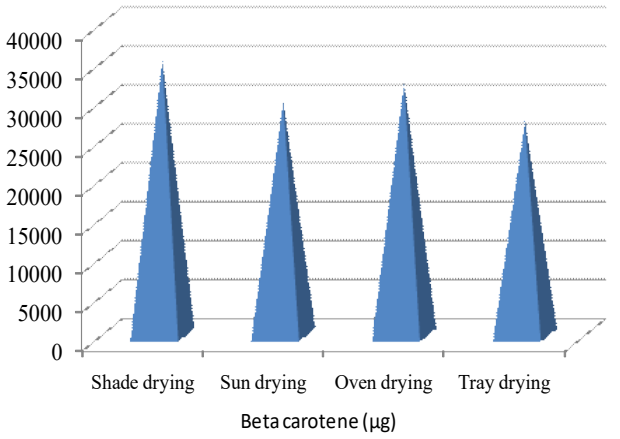

Fig. 4 : Beta carotene content of different processing methods of drumstick leaves

drying method was the best method of dehydration of drumstick leaves. The nutrients like protein, fat, crude fibre, ash and iron retained more in tray as compared to the shade, oven and sun drying methods but Vitamin C and beta carotene was more in shade dray method than other three drying methods. Dehydration was one of the most possible strategies for preservation of green leafy vegetables, which were highly seasonal and perishable too. Value added products can be developed by using drumstick leaves powder in future studies.

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