# Effect of Processing in Physico-Chemical Composition of *Moringa Oleifera* Leaves

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**Abstract: -** *Moringa oleifera*, known as drumstick tree is widely cultivated throughout India. It is widely used as a nutritive herb and possess valuable pharmacological activities. Due to its amazing abilities for various ailments and even some chronic diseases, it is also named as "the miracle tree". Phytochemicals are chemical compounds that are naturally found in plant. Adopting different processing methods will reduce the anti-nutritional content and may enhance the nutritional value. Different drying and processing methods have a great influence on the quality parameters. Different food processing methods will reduce the levels of antinutrients and enrich the nutritional value. It was found that only 20-40% of vitamin A will be retained if leaves are dried under direct sunlight, but 50-70% will be retained if leaves are dried in the shade. High temperature also leads to breakage of protein present in the leaves Hence, the study also aims to evaluate the variation in nutrient content and therapeutic potential due to the effect of processing on *Moringa oleifera* leaves.

**Key Words: —** ***Moringa olifera, Anti-nutritional, Pharmacological activity.***

## I. Introduction

Moringa oleifera has been used as a dietary supplement due to its rich nutritional content. It is an outstanding indigenous source of proteins, vitamins and minerals. The tree contains digestible proteins, iron, magnesium, calcium, vitamins (B6, B2, C) and carotenoids (Rockwood et al., 2013).

*Moringa oleifera* is one of the richest natural sources of provitamin A. Every part of this tree has been found to possess many nutrients. The *Moringa oleifera* plant provides a rich and rare combination of zeatin, quercetin, kaempferol and many other phytochemicals. The leaves are used as a source of vitamins A and C. They are also good sources of vitamin B and are also a source of minerals. The leaves, flowers and immature pods of this plant are used as highly nutritive supplements with many pharmacological properties (Kumar and Pari, 2003).

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Every part of *Moringa oleifera* is a store house of important nutrients. Leaves of *Moringa oleifera* possess: 4 times more calcium and two times more protein than milk, 7 times more vitamin C than oranges, 3 times more potassium and iron than banana and spinach respectively and 4 times more vitamin A than carrots (Thurber and Fahey, 2009). Hence, this plant is unique as it is very rare to find such a diversified nutrient profile in a single plant species (Razis *et al.,* 2014).

Different food processing methods will reduce the levels of antinutrients and enrich the nutritional value (Sallau *et al.,* 2012). It was found that only 20-40% of vitamin A will be retained if leaves are dried under direct sunlight, but 50-70% will be retained if leaves are dried in the shade. High temperature also leads to breakage of protein present in the leaves (Mishra *et al.,* 2012).

## II. Materials and Methods

### *2.1 Collection of raw materials*

Fresh Moringa leaves were collected from Department of Vegetable Science, Kerala Agricultural University, Thrissur. The KAU Moringa variety Anupama was selected for the study. The collected Moringa leaves are shade dried in traditional method (Moringa leaves are laid out on a mat and left to dry for

48 hrs), oven dried leaves ($50^0$C) and steamed leaves (3 minutes). The dried parts were ground and sieved to get uniform flour and the flour was used for analysis.

## III. Results and Discussion

Physical and nutritional constituents of Moringa leaves was carried out in various treatments such as shade dried leaves, oven dried leaves and steamed leaves using standard procedures and the results are furnished in table 1 (a).

Table.1. Nutritional composition of Moringa leaves

| Treatments | Moisture (%) | Protein (g) | Fat (g) | β-carotene (µg) | Vitamin C (mg) | Fibre (g) |
|---|---|---|---|---|---|---|
| Shade dried leaves | $9.10^b$ | $20.35^a$ | $0.20^a$ | $14326^a$ | $51^b$ | $15.78^b$ |
| Oven dried leaves | $10.23^b$ | $17.82^b$ | $0.14^c$ | $12568^b$ | $42^c$ | $16.19^a$ |
| Steamed leaves | $86.21^a$ | $5.12^c$ | $0.18^a$ | $12899^b$ | $58^a$ | $5.99^c$ |
| C.D. | 0.901 | 0.223 | 0.013 | 1.211 | 1.272 | 0.125 |

Values with same alphabet for all parts of Moringa represented in each column form a homogenous group

Steamed leaves showed highest range of moisture content of 86.21 per cent followed by oven dried leaves and shade dried leaves of 10.23 and 9.10 per cent respectively. Based on DMRT, moisture content in fresh leaves, steamed leaves and shade dried, oven dried are statistically homogenous. The highest protein content was observed in shade dried leaves (20.35 g per 100g) and 17.82 g per 100 g observed in oven dried leaves and 5.12 g per 100 g in steamed leaves. A statistically non significance found in shade dried leaves (20.35 g per 100 g) and steamed leaves (5.12 g per 100 g) with a CD value of 0.223. The highest fat content was observed in shade dried leaves of 0.20 g per 100g. Based on one way ANOVA, fat content in Moringa are statistically similar in shade dried leaves and steamed leaves of 0.20 and 0.18 g per 100 g. Moringa shade dried leaves is an excellent source of beta carotene with 14326 µg per 100 g. The highest vitamin C content of steamed leaves, shade dried and oven dried leaves with 58, 51 and 42 mg per 100 g respectively. The Moringa shade dried leaves was observed to have a fibre content of 15.78 g per 100 g.

The oven dried, shade dried and steamed methods significantly affected the proximate composition of moisture, ash, protein and carbohydrate. Adeyemi *et al.* (2011) equally reported significant effect in crude protein, ash, moisture and carbohydrate content of *Moringa oleifera* using different drying methods.

The highest protein content was observed in shade dried leaves (20.35 g per 100g) and 17.82 g observed in oven dried leaves, 5.12 g per 100 g observed in steamed leaves and 6.23 g per 100 g in fresh leaves. According to Ferracane *et al.,* (2008) the protein content of *Moringa oleifera* leaves, shade dried, oven dried and steamed leaves ranged between 6 and 10 % on dry basis. *Moringa oleifera* leaves contain high levels of proteins (6-10 %) and relatively low lipids content (1-2 %).

The highest fat content was observed in shade dried leaves of 0.20 g per 100g. Fat content in Moringa are statistically similar in shade dried leaves and steamed leaves of 0.20 and 0.18 g per 100 g. The lipids content of *Moringa oleifera* leaves, shade dried, oven dried and steamed leaves are between 1-2 % forwarded by Oyetade *et al.,* (2012).

Moringa fresh leaves is an excellent source of beta carotene with 16623 µg per 100 g. A statistically significant difference in beta carotene content was observed in shade dried and oven dried leaves with 14326 and 12568 µg per 100 g respectively. The total carotenoids content ranged between 91 in solar dried leaves and 132 mg/ 100 g in blanched leaves (Djuikwo *et al.,* 2011) Carotenoids content in Moringa leaves was higher in blanched samples compared to fresh samples both before and after drying. Drying had a significant negative effect on carotenoids content (6 to 10 % reduction) in both fresh and blanched leaves. Meanwhile no significant effect of the drying method was observed on carotenoids content (Adefegha and Oboh, 2011).

The decrease in vitamin C with blanching and drying is in accordance with the fact that it is a heat labile vitamin easily oxidized on exposure to air and heat and is also water soluble. In accordance with our observations, Joshi and Metha (2010) have equally observed greater vitamin C losses with electric drying of fresh drumstick leaves compared to solar drying while losses of vitamin C with steam blanching have been reported.

*Moringa oleifera* is a good source of fibre ($11.23 \pm 0.16$ g.$100g^{-1}$) that might be taken as a part of diet to clean the digestive tract by removing potential carcinogens from the body and hence prevents the absorption of excess cholesterol. The fat and carbohydrate content are very valuable as a main source of energy for human body. The same results mentioned by (Sodamade *et al.,* 2013), who revealed that *Moringa oleifera* leaves are nutritionally adequate and given the promising source of dietary minerals in most developing countries.

Minerals like calcium, iron, zinc and phosphorus were analysed in different treatments of Moringa such as shade dried leaves, oven dried leaves and steamed leaves was carried out using the standard procedures and the results are furnished in table 2.

Table.2. Mineral composition in Moringa leaves

| Treatments | Calcium (mg) | Iron (mg) | Zinc (mg) | Phosphorous (mg) |
|---|---|---|---|---|
| Shade dried leaves | 876[a] | 22.12[a] | 0.64[a] | 52.0[c] |
| Oven dried leaves | 648[b] | 17.44[b] | 0.29[b] | 62.2[b] |
| Steamed leaves | 215[d] | 5.28[a] | 0.23[b] | 69.30[a] |
| C.D. | 2.272 | 0.231 | 0.013 | 0.904 |

Values with same alphabet for all parts of Moringa represented in each column form a homogenous group

The Moringa shade dried leaves was found to have higher amount of calcium of 876 mg per 100 g. Oven dried and steamed leaves had a calcium content of 648 and 215 mg per 100 g respectively. Based on one way ANOVA, significant difference observed in all treatments of Moringa. The highest iron content was observed in shade dried leaves (22.12 mg per 100 g). The steamed leaves had iron content of 5.28 mg per 100 g. Moringa shade dried leaves was found to be highest source of zinc with a content of 0.64 mg per 100g. A statistically homogenous group were observed in oven dried and steamed leaves with 0.29 and 0.23 mg per 100 g respectively whereas, no significant difference found in shade dried leaves. Moringa steamed leaves was found to have excellent source of phosphorus with a content of 69.30 mg per 100 g.

The Moringa shade dried leaves was found to have higher amount of calcium of 876 mg per 100 g. Oven dried, fresh leaves and steamed leaves had a calcium content of 648, 256 and 215 mg per 100 g respectively maybe due to the resulting in reduction in moisture content leading to better retention of minerals. Palermo *et al.,* (2014) reported that calcium content in Moringa leaves as 230 mg, shade dried (910 mg), steamed (200 mg) and oven dried leaves (546 mg).

The comparable zinc values for sun and shade dried leaves (0.78 and 0.96 mg vs 0.80 and 0.85 mg respectively) suggest that neither of the processing methods had an advantage in improving zinc quality of *Moringa oleifera* leaves (Mensah *et al,* 2012).

A high content of phosphorus (105.23 ± 0.32 mg.100g$^{-1}$) is important to serve as the main regulator of energy metabolism in cells. Iron (9.45 ± 0.16 mg.100g$^{-1}$) is very important element as a nucleus of hemoglobin, which forms red blood cells in the body (Sodamade *et al.,* 2013)

Total phenol and flavonoid content were analysed using the standard procedures and the results are shown in Table 3.

Table.3. Total phenol and flavonoid content in Moringa leaves

| Treatments | Total phenol content (mg) | Total flavonoid content (mg) |
|---|---|---|
| Shade dried leaves | 19[a] | 1.96[b] |
| Oven dried leaves | 11[b] | 1.32[b] |
| Steamed leaves | 15[a] | 2.58[a] |
| C.D. | 0.011 | 0.006 |

Values with same alphabet for all parts of Moringa represented in each column form a homogenous group

The highest total phenol content was observed in shade dried leaves (19 mg per 100 g). Based on DMRT, total phenol content in shade dried and steamed leaves form a statistically homogenous group but significant changes were observed in oven dried leaves. The steamed leaves were observed to have high flavonoid content of 2.58 mg per 100 g. Based on one way ANOVA, total flavonoid content in oven dried and shade dried leaves were statistically homogenous.

The highest total phenol content was observed in shade dried leaves (19 mg per 100 g). The steamed leaves were observed to have high flavonoid content of 2.58 mg per 100 g. In plant materials, a number of phenolic compounds are linked to various cell wall components such as carbohydrates and proteins. Their destruction therefore will lead to release of these compounds. Higher total phenolic content has previously been reported in roasted Moringa leaves (Parwani *et al.,* 2016).

Phenolic compounds and flavonoids are very important constituents that have antioxidant activity by scavenging free radicals and occurred in several kinds of plants; the total phenolic content determination in Moringa leaves revealed that the type of extraction solvent is a limiting factor in the extraction of phenolics and flavonoids (Luqman *et al.,* 2012).

Anti-nutritional factors like phytates, oxalates and tannin were analysed using the standard procedures and the results are shown in table 4.

Table.4. Anti-nutritional factors of Moringa leaves

| Treatments | Phytates (mg) | Oxalates (mg) | Tannin (mg) |
|---|---|---|---|
| Shade dried leaves | 16[b] | 16.7[a] | 1.028[a] |
| Oven dried leaves | 19[a] | 11.9[b] | 1.039[a] |
| Steamed leaves | 16.2[b] | 10.9[b] | 0.235[b] |
| C.D. | 1.103 | 0.132 | 0.001 |

Values with same alphabet for all parts of Moringa represented in each column form a homogenous group

The highest phytate content of Moringa oven dried leaves was found to be 19 mg per 100 g followed by steamed leaves and shade dried leaves with 16.2 and 16 respectively. Based on one way ANOVA, homogenous group observed in shade dried and steamed leaves with a C.D. value about 1.103 mg. Moringa shade dried leaves was found to be highest source of oxalate with a content of 16.7 mg per 100g. The oven and steamed leaves were found statistically similar with 11.9 and 10.9 mg per 100 g respectively whereas no significant difference observed in shade dried leaves. Moringa oven dried leaves was found to have higher source of tannin with a content of 1.039 mg per 100 g. Based on DMRT, oven dried and shade dried leaves are statistically homogenous with 1.028 and 1.095 mg per 100 g respectively whereas no significant in steamed leaves with 0.235 mg per 100 g. Makkar and Becker (1997) reported that antinutritional factors like phytates, oxalates and tannin are rich source in Moringa leaves, shade dried, oven dried and steamed leaves.

The oven-dried leaves and steamed leaves (2.76 and 2.83 mg/100 g) had the lowest oxalate value which shows that oven-drying is the best method of reducing oxalate content of *Moringa oleifera* leaves. The phytate values for sun drying, oven drying, steamed and shade dried leaves (9.09 mg/100 g, 5.95 mg/100 g, 9.44 mg/100 g and 9.42 mg/100 g) respectively were higher than the toxic limit of phytate (5.00 mg/100 g) (Munro and Basrer, 2009). The high level of phytate in these leaves may pose some health challenges for these samples.

## IV. Conclusion

The study also evaluated the variation in nutrient content and medicinal properties due to the effect of processing on Moringa leaves. This was done in comparison of the effect of processing in fresh leaves, shade dried leaves (room temperature), oven dried leaves ($50^0$ C for 8 hours) and steamed leaves (3 minutes). Effect of processing on the nutritive value and medicinal properties reveal that shade drying is better than oven drying and steaming. Hence there is immense scope for developing nutraceuticals and value-added products from different parts of moringa tree.

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