Process optimization for drying of drumstick leaves

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PROCESS OPTIMIZATION FOR DRYING OF DRUMSTICK LEAVES

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ABSTRACT

There are many varieties of green leafy vegetables which are though rich in micronutrients, but are usually discarded or are not used for human consumption. One such leaf, a rich source of micronutrients but still under exploited is Moringa leaf (Moringa oleifera). Dried Moringa leaves can be stored during off seasons however drying causes degradation of colour characteristics which reduces its marketable value. In present investigation, efforts were made to analyze the effect of different pre treatments and drying methods such as sun, shade and hot air oven drying at different temperatures (50, 60, 70°C) on the nutritive value of the selected leaf for Moringa leaves drying. The results revealed that Moringa leaves pre-treated with 0.1% sodium bicarbonate and dried in shade drying gave better results in drying characteristics and nutritional analysis such as carbohydrates - 33.86g, fibre - 8.18g , protein - 27.40g , vitamin-C – 13.21mg, chlorophyll content-3.1 mg respectively. Similarly in oven drying at 50°C Moringa leaves treated with Na₂CO₃ shows the best result. The nutritional content in oven dried Moringa is iron – 15.2mg, carbohydrates – 28.6g, fibre - 6.5g , protein - 24.40g , vitamin-C – 10.81mg, chlorophyll content-2.4 mg respectively. On the basis of obtained results it could be concluded that shade drying treated with Na₂CO₃ is superior to that of sun and hot air oven drying in terms of nutritional content.

Key words: Moringa oleifera, dehydration, sun drying, shade drying, oven drying, biochemical analysis

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1. INTRODUCTION

Drumstick leaves (*Moringa oleifera*) is one of them, which is available at no cost and is very rich in all the micronutrients. *M. oleifera*, commonly referred to simply as "*Moringa*", is the most widely cultivated species of the genus *Moringa*, which is the only genus in the family Moringaceae. It is an exceptionally nutritious vegetable tree with a variety of potential uses. The tree itself is rather slender, with drooping branches that grow to approximately 10 m in height. The "*Moringa*" tree is grown mainly in semi-arid, tropical, and subtropical areas, while it grows best in dry sandy soil, it tolerates poor soil, including coastal areas. It is a fast-growing, drought resistant tree that is native to the southern foothills of the Himalayas in northwestern India. The immature green pods called “drumsticks” are probably the most valued and widely used part of the tree. They are commonly consumed in India and are generally prepared in a similar fashion to green beans and have a slight asparagus taste. The seeds are sometimes removed from more mature pods and eaten like peas or roasted like nuts. The flowers are edible when cooked, and are said to taste like mushrooms. The leaves are highly nutritious, being a significant source of beta carotene, Vitamin C, protein, iron, and potassium. The leaves are cooked and used like spinach. In addition to being used fresh as a substitute for spinach, its leaves are commonly dried and crushed into a powder, and used in soups and sauces. Murungakai, as it is locally known in Tamil Nadu and Kerala, is used in Siddha medicine. Its leaves are full of medicinal properties (Pandhre GR, Satwase AN.,(2011).

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Incorporation of dried leaves in food products can have good sensory acceptance. Lalitha and Sathya (2003) incorporated curry leaves, and coriander leaves powder in commonly used instant mixes such as dhal powder, bajji mix and vadai mix and reported that all products were equally acceptable. Singh and Awasthi (2003) investigate the effect of powder made from kachnar, colocasia and curry leaves incorporated food products and found that it is significantly acceptable. The food products prepared using powders of amaranth, curry leaves, gogu and mint were rated as highly acceptable for all the sensory attributes and were scored from good to excellent on five point scale Lakshmi and Vimala (2000). The effect of blanching prior to dehydration in cross air flow drier was studied in seven leafy vegetables viz., dhantu, khirkhire, honagone, chakota, palak, kachiaandal fenugreek showed the highest retention of chlorophyll (Premavalli et al., 2001). Blanching of amaranth in hot water (95 ± 3°C) for one minute followed by cooling in running tap water and dipping in 0.5 per cent solution of potassium meta bisulphite for one minute prior to drying in cabinet drier showed higher retention of chlorophyll, ß-carotene and lowered non-enzymatic browning (Negi and Roy, 2001)

Drying is almost certainly the oldest method that humans have practiced to preserve food for future use. Drying foods in sunlight reduced the weight and volume of the foods so that they could be more easily stored and transported by our ancestors. Drying occurs by effecting vaporization of the liquid by supplying heat to the wet feedstock. As noted earlier, heat may be supplied by convection (direct dryers), by conduction (contact or indirect dryers), radiation or volumetrically by placing the wet material in a microwave or radio frequency electromagnetic field (Arun S. Mujumdar and Sakamon Devahastin 2001). Over 85 percent of industrial dryers are of the convective type with hot air or direct combustion gases as the drying medium. Over 99 percent of the applications involve removal of water.

The major challenge that is being faced in the moringa leaves production is its lower shelf life. Thus the objective of our project is

- To pre-treat the sample with sodium chloride and sodium bicarbonate.
• To dehydrate the leaves with various drying methods (sun, shade, hot air oven) and temperature (50°C, 60°C, 70°C).
• To estimate Proximate analysis of the dehydrated drumstick leaves
• To determine the drying characteristics and obtain a solution by comparative study.

2. MATERIALS AND METHODS:
The drumstick leaves, one of green leafy vegetable was obtained from local vegetable market. These leaves were easily available across every corner even in remote areas. The leaves were also grown in many households especially in villages.

Selection of drumstick leaves
↓
Cutting
↓
Washing
↓
Pretreatment (NaCl & Na₂CO₃)
↓
Drying using sun, shade and Hot air oven (50°, 60° and 70°C)
↓
Grinding
↓
Optimization

Fig.1 Methodology

Independent variables are type of drying (sun, shade, hot air oven drying) and temperature of hot air oven (50°C, 60°C, 70°C). Dependent variables are moisture content, ash, crude fibre, carbohydrate, protein, chlorophyll, and vitamin-C.

The drumstick leaves were pretreated to retain the colour. The drumstick leaves were, washed and then pretreatment was done with sodium chloride (2% NaCl) and sodium
bicarbonate (0.1% Na$_2$CO$_3$). Then the water is drained and drying is done. The leaves are spread on a large tray and different types of drying are carried out (sun, shade, hot air oven drying).

**DRYING**

The techniques used for dehydration were (i) Sun drying; (ii) Shade drying and (iii) Hot air oven drying

*Sun drying:*

The leaves were placed on large tray. The tray were placed in a direct sunlight on a roof away from dust to assure even drying. During drying the temperature of the leaves were noted. The temperature is about 26°C.

*Shade drying:*

In shade drying, the leaves were spread on large tray but instead of keeping them on the roofs the leaves were kept in the room only. The room selected for shadow drying was well ventilated. Natural current of air was used for shadow drying the leaves.

*Hot air oven drying:*

The leaves were spread on the trays and kept in hot air oven (Hasthas Hot air oven). The leaves were dried in the hot air oven by forced air technique. The temperature was maintained at 50°C, 60°C, 70°C and the leaves were dried. The dried leaf samples were then analyzed for (i) Proximate composition (Protein, fiber, carbohydrate). (ii) Vitamin (vitamin C). (iii) Minerals (Iron).

**NUTRITIONAL ANALYSIS**

Nutritional analysis was done as described in the table given below

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Determination methods</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content</td>
<td>Oven method</td>
<td>Sadhasivam and Manikam, 2008</td>
</tr>
<tr>
<td>Ash</td>
<td>Muffle furnace</td>
<td>Sadhasivam and Manikam, 2008</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>Alkali treatment method</td>
<td>Sadhasivam and Manikam, 2008</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>Anthrone</td>
<td>Sadhasivam and Manikam, 2008</td>
</tr>
<tr>
<td>Protein</td>
<td>Kjeldahl</td>
<td>Sadhasivam and Manikam, 2008</td>
</tr>
<tr>
<td>Iron</td>
<td>Spectrophotometer</td>
<td>Sadhasivam and Manikam, 2008</td>
</tr>
</tbody>
</table>
3. RESULTS AND DISCUSSIONS:

Drying Characteristics

The time required for drying in different drying condition is shown in Fig.4.2. There was wide variation in drying time. The hot air oven drying method took least time of 140 minutes for drying due to higher temperature and the moisture content dried Moringa leaves was about 10.3%. In shade and sun drying methods required maximum time of about 240 and 200 minutes to reach the final moisture content of 12 – 14%. The rate of moisture removal in hot air oven drying was much faster than the sun and shade drying. The final moisture content of dried leaves was in the range of 8-15%. The moisture content of Moringa leaves in hot air oven drying at 70°C was comparatively low because of higher temperature. In shade drying the moisture content is higher because of lower temperature.

The change in moisture content with respect to time for controlled, NaCl and Na₂CO₃ treated Moringa leaves are shown in the figure 4.2, 4.3, 4.4. In fenugreek samples for fresh leaves the moisture content was in the range 77.8% (Pallavi Joshi and Dipika Mehta, 2010)

Protein Content

The protein content in the controlled, NaCl and Na₂CO₃ treated dried leaves was in the range of 20.42 - 26.78 g per 100 g. Maximum protein content of 27.4 g was in the shade -dried moringa leaves treated with Na₂CO₃ and the minimum was in the oven dried at 70°C treated with NaCl. At lower temperature the protein content at 50°C is 23.75 g when compared to sun and oven drying at 60 and 70°C which is about 16 – 18 g respectively. The difference in the protein content of the dried moringa leaves was shown in fig 4.5.

Fibre Content

The fibre content in the dried moringa leaves was in the range of 5.3 to 8.8g with the highest level in shade dried moringa leaves 8.1g followed by sun dried 7.92g and the minimum values of fibre were found in oven dried moringa leaves at 70°C which is about
5.12g/100g of moringa leaves as shown in fig 4.7. Shade drying treated with Na$_2$Co$_3$ contains higher fibre content when compared with oven dried moringa leaves. At higher temperature the fibre content is low, as fibre is heat sensitive.

**Carbohydrate Content**

Carbohydrate content of moringa leaves was found to be in the 34.76g/100g. Sample which was shade dried and treated with Na$_2$Co$_3$ contains higher carbohydrate content of 34.45g than the oven dried sample at 70°C which is about 24.34g respectively. Oven drying at 50°C contains carbohydrate content of about 25 - 27g.

**Iron**

Fresh drumstick leaves have an iron content of 0.085 mg/ 100 g of iron. Maximum amount of iron content was in the shade dried moringa leaves 16.21 mg/ 100 g leaf powder followed by sun dried moringa leaves 15.12 mg/ 100 g leaf powder and it was the lowest in oven dried moringa leaves at 70°C is 9.42 mg/ 100 g leaf powder. The difference in the iron content of the dried moringa leaves was significant as shown fig 4.5

**Chlorophyll Content**

The maximum retention of chlorophyll was in shade dried moringa leaves is 2.7mg and followed by oven dried moringa leaves at 50°C is 2.2 mg. Shade drying though took longer time than sun and oven drying. Shade drying treated with Na$_2$Co$_3$ has the maximum color retention than shade drying with NaCl. The difference between the dried moringa leaves of drumstick leaves was significant.

**Vitamin C**

Vitamin C content of the dried leaves was less than the fresh moringa leaves. The maximum amount of vitamin C was in shade - dried moringa leaves 12.80 mg as in this technique the leaves were not exposed to direct heat and air. As vitamin –C is heat sensitive 60 and 70°C vitamin C content is 6-8mg which is relatively low. Maximum amount of Vitamin-C is retained in shade drying treated with Na$_2$Co$_3$ which contains 12.80 mg/100 g of moringa leaves followed by oven dried at 50°C is 11.8 mg/100 g of moringa leaves.
**Fig. 2** Drying characteristics for untreated moringa leaves

**Fig. 3** Drying characteristics for pretreated Na$_2$Co$_3$ moringa leaves

**Fig. 4** Drying characteristics for pretreated NaCl moringa leaves
Fig. 5 Effect of drying method on temperature on protein content of moringa leaves

Fig. 6 Effect of drying methods and temperature on CHO content of moringa leaves

Fig. 7 Effect of drying methods and temperature on fibre content of moringa leaves
Fig. 8  Effect of drying methods and temperature on iron content of moringa leaves

Fig. 9  Effect of drying methods and temperature on chlorophyll content of moringa leaves

Fig. 10  Effect of drying methods and temperature on vitamin-c content of moringa leaves
4. SUMMARY AND CONCLUSION:

Drying of drumstick leaves resulted in concentration of nutrients. The shade drying of leaves had high nutritional properties during the process which increased the consumer acceptance of the product than the outer drying methods. Pretreatment the sample with 2% NaCl and 0.1% Na₂CO₃ helped in better retainment. The dried sample at 70°C took less time to dry until the desired moisture content of about 8.9%. From the studies conducted it can be concluded that: The best method for drying of drumstick leaves was shade drying treated with Na₂CO₃ as it showed the higher values of nutritional content in iron - 16.3mg, CHO - 33.86g, fibre - 8.18g, protein - 27.40g, Vitamin-C – 13.21mg, chlorophyll content-3.1 mg respectively. Another reason for this conclusion is its lower nutritional loss in shade drying treated with Na₂CO₃ and colour retention is high. The moringa leaves at 70°C shows the higher nutritional loss because of higher temperature. Next to shade drying, moringa leaves treated with Na₂CO₃ in hot air oven at 50°C shows best nutritional value. So, drying of drumstick leaves promotes wider application by incorporating in food products. For further studies, the parameters like drying temperature, different pretreatment and by varying moringa leaves thickness, etc., can be analysed for the best results.

REFERENCE


