Dried Ponnaganni leaves (*Alternanthera sessilis*): A Nutritious Product with the Potential for Value Addition

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Abstract

Green leafy vegetables are an excellent source of nutrients like vitamins, minerals and dietary fibre and widely included in a habitual diet of the rural populace. Due to their perishable nature and seasonal availability, fresh green leafy vegetables are processed quickly and cooked before it served for human consumption. Considerable efforts have taken to increase the shelf life of green leafy vegetables by conventional drying methods and presumed as a low-cost/convenient technology in many parts of the world. Hence, this study aimed to preserve Ponnaganni (*Alternanthera sessilis*), underutilized green leafy vegetables, through cabinet drying and determine the impact of cooking the leaves before drying on its nutritional, functional and phytochemical quality. Collected Ponnaganni leaf bundle from the local vegetable market were cleaned, washed, separated the leaves then cooked by boiling for 20 min, simmering for 10 min and steaming for 10 min. The cooked and uncooked leaves were dried at 60°C for 4-5 hours in a cabinet dryer, made into powder and stored in the air-tight containers under refrigeration temperature. The quality of dried leaves was assessed by analyzing their nutrient content, functional properties and phytochemical profile as per the standard methods. Results of the nutrient analysis revealed that dried Ponnaganni leaves were high in protein (24.25g%), minerals (18.94g%) and crude fibre (8.13g%) and low in moisture (6.69%). Also the dried leaves exhibited high water absorption capacity (3.82 g/g), oil absorption capacity (1.66 g/g) and emulsifying activity (41.05%). Phytochemical screening reports that aqueous extract of dried Ponnaganni leaves were loaded with many phytochemicals except anthocyanin. The cooked leaves showed a noticeable change in the nutrients content, functional properties and phytochemical profile compared to uncooked leaves. The findings suggest that dried Ponnaganni is a nutritious product and it can be used in food formulations that necessitate high protein, minerals and fibre.

**Keywords:** Ponnaganni- Cooking - Proximate analysis - Functional properties - Phytochemicals

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Introduction

Green Leafy Vegetables (GLVs) are an indispensable source of quality nutrients for vegetarians and provide essential vitamins and minerals for maintaining health and wellbeing. It also contains bioactive substances that fight against various metabolic and degenerative diseases upon regular consumption. GLV consumption is affected by their perishability, low palatability, and the presence of anti-nutritional factors. They are mostly processed/ cooked before it is being served for humans however the method of preparation and processing conditions influences their palatability and nutrient quality. Studies indicate that GLV consumption in India is lower and found a large gap between actual and recommended levels of GLVs intake despite the decades of concern and publicity [1].

India is bestowed with many GLV with potential health benefits, but only a few are included in the daily diet. Ponnaganni (Alteranthera sessilis) is an underutilized GLV, otherwise known as sessile joyweed and dwarf copperleaf [2]. The leaves of Ponnaganni contains appreciable amount of protein, carbohydrate, dietary fibre, β-carotene, Vitamin B₁, Vitamin B₂ and phosphorous. Also they contain phytochemical compounds especially stigmasterol, campsterol, β-spinasterol, palmitates of sterol, α-, β- spinasterol etc., owing to its anti-diabetic, anti-cancer, anti-ulcer, antioxidant, anti-malarial, anti-inflammatory anti-fungal activities [3]. It is widely used as a local medicinal plant to treat lung diseases, asthma, bronchitis, chest tightness, hepatitis and several eye infections. Shehzad and colleagues investigated the anti-pyretic effects of the ethanolic extracts of leaves of Alternanthera sessilis using albino rats. The ethanolic extracts applied at the dose concentration ranging from 200 mg/kg to 400 mg/kg of body weight showed a significant reduction in normal body temperature compared with standard anti-pyretic agents due to presence of lupeol and β-sterols [4].

Ponnaganni leaves undergo deteriorative changes after harvest and lose their freshness very quickly. They are perishable due to their high moisture content (>75%) and have a limited shelf life at ambient conditions. Attempts have been taken to increase the shelf life of Ponnaganni by drying sime vegetable drying is a traditional method of preservation. Naidu and colleagues [5] reported that adverse drying conditions could lead to several irreversible chemical and biological reactions in food, accompanied by several structural, physical and mechanical modifications. It is found that the leafy vegetables subjected to pretreatments before drying showed better nutritional value than untreated by Hammed et al. [6]. The effect of pretreatments and drying methods on the quality of Ponnaganni leaves have not been studied so far. Hence this study aimed to determine the nutritional and functional properties of Ponnaganni leaves and the effect of cooking on their quality.

Materials and Methods

Ponnaganni leaves were collected from a local market in the Dindigul, Tamil Nadu, India. Leaf samples were submitted to the Department of Biology, The Gandhigram Rural Institute-Deemed to be University, Gandhigram for botanical identification and it found to be Ponnaganni (Alternanthera sessilis). The experiments were carried in the Department of Home Science, The Gandhigram Rural Institute-Deemed to be University, Gandhigram. The Analytical Grade (AR) chemicals were used for the nutritional, functional and phytochemical analysis of Ponnaganni leaves.

The collected bundles of leaves were checked for its quality and sorted. The leaves were separated from the stalk manually, washed the leaves with water thoroughly to remove the dirt and then surface dried to remove the excess water. The leaves were loaded into the cabinet drier (Bioticron Instruments, Tamil Nadu, India) maintained at 60°C temperature and allowed to dry for 4-5 hours. The dried leaves grind using the blender and stored in air-tight containers under refrigeration temperature until further analysis. The prepared leaf powder was labeled as control (T₀).
To determine the effect of pretreatments on Ponnaganni leaves, fresh cleaned leaves were subjected to various heat treatments such as boiling (T1) for 20 minutes, steaming (T2) for 10 minutes and simmering (T3) for 10 minutes using distilled water followed by cabinet drying at 60°C for 4-5 hours. After drying, the leaves were made into powder and packed in air-tight containers, then stored at refrigeration temperature until further analysis. The nutrient content of the powdered samples were analyzed by using AOAC [7] methods. The moisture content was measured using Digital Moisture balance (Shimadzu, Japan) and expressed the results in percentage. Crude protein content was determined by Microkjeldhal method using Kelpplus nitrogen analyzer (Pelican Equipment Inc, Chennai, India) and adopted nitrogen conversion factor of 6.25 to calculate protein content. Mineral content was estimated by incinerating the sample at 600°C in a Muffle furnace for 6 hours and record the ash content at the end. Crude fibre content was determined using Fibroplus instrument (Pelican Equipments, Chennai, India) with strong acid and alkali. Crude protein, mineral and crude fibre contents were expressed as g/100g on wet basis.

Functional properties such as bulk density [8], water absorption capacity and oil absorption capacity [9], emulsifying activity and foaming capacity [10] of the leaf powders were determined by adopting standard protocols. The results were expressed in g/ml for bulk density, g/g for water/oil absorption capacity, the percentage for both emulsifying activity and foaming capacity.

The aqueous extract was prepared by mixing the leaf powders with distilled water at 1:20 ratio and kept in a shaking water bath for overnight at 30°C temperature at 100 rpm speed for phytochemical screening. After that the suspensions were centrifuged at 2000g for 15 minutes and collected supernatant for the analysis. Aliquot extracts taken to test Phytochemicals presence such as phenolic compounds, alkaloids, glycosides, steroids, tannins, saponins, flavonoids, quinines, anthocyanins and coumarins by adopting the method described in the literatures [11] and [12].

**Statistical Analysis**

All the analyses were carried out in triplicates. The results were analyzed in ANOVA using SPSS software version 17. Duncan Multiple Range Test (DMRT) at 95% confidence level (p<0.05) was used to test the Means with a significant difference.

**Results and Discussion**

Nutrient contents of the untreated and treated Ponnaganni leaves are presented in Table 1.

<table>
<thead>
<tr>
<th>Pretreatments</th>
<th>Nutrient content per 100g</th>
<th>Crude Protein (g)</th>
<th>Minerals (g)</th>
<th>Crude Fibre(g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>6.69±0.10^a</td>
<td>24.25±0.59^d</td>
<td>18.94±0.21^d</td>
<td>8.13±0.61^c</td>
</tr>
<tr>
<td>T1</td>
<td>5.41±0.24^e</td>
<td>41.25±0.01^a</td>
<td>12.51±0.35^e</td>
<td>12.57±0.33^b</td>
</tr>
<tr>
<td>T2</td>
<td>4.96±0.35^b,e</td>
<td>28.36±1.78^c</td>
<td>24.32±0.88^b</td>
<td>8.45±0.64^c</td>
</tr>
<tr>
<td>T3</td>
<td>4.68±0.07^c</td>
<td>32.77±0.01^b</td>
<td>20.87±0.29^b</td>
<td>10.24±1.39^b</td>
</tr>
</tbody>
</table>

Values presented as Mean ± Standard Deviation. Superscripts in the same column indicate mean with a significant difference at p<0.05;

T0 represents control and T1, T2 and T3 denotes boiled, steamed and simmered Ponnaganni leaf powders respectively.

The dried Ponnaganni leaves (T0) contain 6.69% moisture, 24.25g crude protein, 18.94g minerals and 8.13g crude fibre and suggest that they are rich in protein and minerals. This may be due to removal of moisture from the leaves and results in the concentration of nutrients. However cooking before drying may alter the nutrient content of the leaves. A significant difference (p<0.05) in the moisture content of control compared to the cooked leaves was observed. T0 has recorded the highest moisture content of
6.69 percent and the lowest found in T3 (4.68%). The protein content was higher in T1 samples (41.25g/100g) than in other leaves ranged from 24.25 to 32.77 g/100g. T2 was found to be high in mineral content of 24.32 g/100g followed by T3 (20.87 g/100g) compared to T0 (18.94 g/100g). The crude fibre content of treated leaves showed higher crude fibre content except for T2, ranging between 8.45 and 12.57 g/100g. These findings suggest that cooking before drying influenced have a strong influence on the nutrient content of the leaves. Kala & Prakash [13] have reported that cooking green leafy vegetables such as Kikkerai, Shepu and Spinach generally results in moisture loss and causes a significant (p≤0.05) increase in the protein content of the greens. The concentration effect on nutrients upon dehydration also reported by Joshi & Mehta [14]. They found that drumstick leaves dried by sun, shadow and oven drying methods showed higher nutrient content than fresh leaves. Gupta and colleagues [15] reported that the moisture content of blanched and oven dried GLVs at 60°C for 10-12 hours ranged from 3.5 to 7.9% and no significant differences in ash content were observed due to dehydration.

<table>
<thead>
<tr>
<th>Pretreatments</th>
<th>Functional Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bulk Density (g/ml)</td>
</tr>
<tr>
<td>T0</td>
<td>0.46±0.02a</td>
</tr>
<tr>
<td>T1</td>
<td>0.55±0.03b</td>
</tr>
<tr>
<td>T2</td>
<td>0.62±0.03c,b</td>
</tr>
<tr>
<td>T3</td>
<td>0.67±0.03a</td>
</tr>
</tbody>
</table>

Values presented as Mean ± Standard Deviation. Superscripts in the same column indicate mean with a significant difference at p<0.05;

WAC and OAC denote Water Absorption Capacity and Oil Absorption Capacity. T0 represents the uncooked and T1, T2 and T3 represent boiled, steamed and simmered Ponaganni leaves respectively.

Functional properties are the key phenomenon in determining the quality of food ingredients and suitability in different food applications. It is influenced by the structure and composition of carbohydrates, protein, lipid, fibre and minerals [16]. The functional properties of dried Ponaganni leaf powders are given in Table 2. The control leaves exhibited bulk density ranged between 0.46 and 0.67 g/ml. The WAC and OAC of dried Ponaganni leaves were comparable with cooked leaves (3.07-3.82 g/g and 1.44-1.68 g/g respectively). The dried Ponaganni leaves showed moderate emulsion activity (41.05%) while it got increased after cooking to 49.88%. The cooked samples recorded poor foaming capacity (3.99-8.64%) than control (16.64%) except for T3 (17.30%).

Ijarotimi and coworkers [17] reported that the WAC of Moringa seed flour was 80 percent and it could be due to the high protein content of Moringa seed flour (18.86-21.15 g/100g) which may have a higher affinity towards water. Mune and Mune et al. [18] found significantly (p<0.05) higher WAC and OAC in Moringa leaf flour (3.17 and 1.46 g/g respectively) compared to Moringa seed flour which were 1.03 and 0.91 g/g respectively. While the emulsifying and properties of Moringa seed flour was significantly (p<0.05) higher than that of leaf flour. High emulsifying capacity (52.17%) at pH 9, oil/water ratio of 1/2 v/v and flour concentration of 4% (w/v). Similarly the foaming capacity was found to be higher (87.50%) at pH 9 and flour concentration of 4% (w/v). Their findings suggest that emulsifying and foaming properties of Moringa leaf and seed flours are influenced by pH, concentration and oil to water ratios.

Table 3 reveals the qualitative analysis of the phytochemicals in Ponaganni leaf powders. It shows that aqueous extracts of T0 showed the presence of phenols, steroids, alkaloids, glycosides,
tannins, quinine, flavonoids and coumarins an absence of anthocyanin. Cooking before drying has affected the phytochemical profile of the leaf powders. Steroids, alkaloids, quinine and flavonoids were destroyed upon cooking however coumarin was resistant to cooking. Similar results were reported by Unmate and Marathe [19] who found alkaloids, tannins, flavonoids, coumarin, phenolics, phlobatannins, terpenoids, steroids, cardenolins and saponin in the extracts of A. sessilis. The phytochemical profile changes upon cooking might result from thermal degradation, which led to the extraction of phytochemicals due to the destruction of cellwall in green leafy vegetables [20].

<table>
<thead>
<tr>
<th>Phytochemicals</th>
<th>Pretreatments</th>
<th>T₀</th>
<th>T₁</th>
<th>T₂</th>
<th>T₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenols</td>
<td>+</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steroids</td>
<td>+</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkaloids</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Glycosides</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saponins</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tannins</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Quinones</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Flavonoids</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Anthocyanin</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Coumarins</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

‘+’ indicates presence and ‘-’ indicates an absence of the particular phytochemicals.

T₀ represents the control and T₁, T₂ and T₃ denotes boiled, steamed and simmered Ponnaganni leaves respectively.

Conclusion

Our findings reveal that dried Ponnaganni leaf is high in nutrients like protein, minerals and fibre than fresh leaves due to the concentration of nutrients. They also exhibited good water/oil absorption capacity, emulsion activity and moderate foaming capacity because of its composition. Although the phytochemical profile of the dried leaves was affected by pretreatments i.e., cooking before drying, most phytochemicals were soluble in water. It shows that dried Ponnaganni leaves have the potential for value addition and development of nutrient-dense foods.

Acknowledgment

The authors would like to thank Ms. Nithya, Lab Technician & Ms. I. Maheswari, Ph.D. Scholar, Ms. Musfrirabamu, Ms. Nandini, Ms. Nirmala and Ms. Yuvathi of III B.Sc. Home Science students in the Department of Home Science, The Gandhigram Rural Institute-Deemed to be University, Gandhigram for their timely help in completing the analytical work.

Conflict of Interest No conflict of interest.

Authors Contribution

Dr. R. Sahul Hameed has conceptualized the study, interpreted the results and prepared the manuscript. Ms. J. Kowsalya has conducted this study and reported the results with statistical analysis for manuscript preparation.

References


