Nutraceutical potential of *Mucuna utilis* Wall. – A lesser known legume

Prabha Y Bhogaonkar and Prachi P Kshirsagar*

Department of Botany, Govt. Vidarbha Institute of Science and Humanities, Amravati-444 604, Maharashtra, India

*Agharkar Research Institute, Pune-411 004, Maharashtra

Received 1 October 2011; Accepted 16 October 2012

*Mucuna utilis* Wall. a native of South Asia and Malaysia is widely grown throughout the tropics. It is used as a minor food crop in several countries of Asia and Africa. In Nigeria leaves are used as herbal medicine. In South East Asia, the immature pods and leaves are used as vegetable. It is a lesser known source of food in Maharashtra (India) and mostly cultivated in home yards. Young pods are used as salad or made in to vegetable and pickles. Objective of the present study is to understand nutritional potential of these tender pods. Fresh as well as shade dried material was used for estimation of moisture content, chlorophyll, anthocyanin, lycopene, vitamin-C, vitamin-A, crude protein, crude fibre, lipids, fat, reducing and non-reducing sugars, total soluble sugars, starch, total nitrogen and phenols. Mineral content was estimated in terms of ash yield and further analysis was carried out for qualitative and quantitative estimation of different elements. Material was also screened for presence of bioactive molecules. The medicinal properties of anthraquinones, flavonoids, leucoanthocyanin, hydroquinone, catechol, saponin and polyoses present in these pods have been discussed and proposed to be explored for their potential medicinal and nutritional values.

**Keywords:** *Mucuna utilis*, Bioactive molecules, Lesser known legume, Edible, Nutraceutical, Wild vegetable, Famine food.

**IPC code; Int. cl. (2011.01) – A61K 36/00**

**Introduction**

For many years the importance of wild plants to subsistence agriculture in the developing world as food supplement and as a means of survival during times of drought and famine has been overlooked. Generally, the consumption of such wild food has been and still is being under-estimated. Consumption of wild edible plants seems more common and widespread in food insecure areas where a wide range of species are consumed. Local people know about the importance and the contribution of wild plants to their daily diet as well as are aware of possible health hazards and precautions to be taken.

Legume family is third largest among flowering plants, comprising of approximately 650 genera and 20,000 species and is the second most important plant source of human nutrition. *Mucuna utilis* Wall. is a native of South Asia and Malaysia, but presently it is widely grown throughout the tropics. It is used as a minor food crop in several countries of Asia and Africa. During the survey of wild and less known edibles conducted for North Maharashtra during 2008-2010 by authors, young pods of this species were found to be consumed locally. They are believed to increase blood and are used to treat anaemia. It is one of the popular medicinal plants of India and is a constituent of more than 200 indigenous drug formulations. All parts of the species are known to have high medicinal value.

In Maharashtra *M. utilis* is commonly known as *Kuirie*, mostly cultivated in home yards. Young pods are used as salad or made in to vegetable and pickles; they are also shade dried and used after boiling whenever needed.

**Materials and Methods**

**Sample collection**

Seeds were collected from local people of Shirpur, Dist. Jalgaon in North Maharashtra (Plate 1) and plants were grown in botanical garden of the institute. Plant was identified using standard flora and voucher specimen was deposited at the herbarium of Department of Botany, Govt. Vidarbha Institute of Science and Humanities, Amravati (voucher specimen no. PPK-98).
Sample preparation

Young pods were collected during the month of October-November; thoroughly washed after removing seeds and dried under shed and powdered. For analysis fresh material as well as dry powder was used. Material was preserved at 4°C.

Sample analysis

**Moisture content:** Sample was kept in hot air oven at 100°C and weighed. Loss in weight was considered as a measure of moisture content in percent.\(^5\)

**Ash:** The sample (10 g) was weighed in a silica crucible and kept in a muffle furnace for about 5-6 h at 600°C; cooled in a desiccator and weighed. Weight of ash gives mineral content.\(^6\)

**Crude fibre:** Crude fibre content in the sample was estimated according to Maynard (1970) procedure.\(^7\)

**Total carbohydrates:** The sample extract was prepared by hydrolyzing the test sample in 2.5N HCl for three hours in boiling water bath, followed by neutralizing with sodium carbonate. It was then centrifuged, supernatant collected and analysis was carried out following Hedge and Hofreiter (1962) procedure.\(^8\)

**Starch:** Plant tissue was homogenized in hot ethanol and then extracted with distilled water and perchloric acid. Starch content was estimated in terms of sugars produced by digestion of starch using Anthrone reagent spectrophotometrically at 630 nm and multiplying the sugar value thus obtained by starch factor (glucose content × 0.9).\(^9\)

**Reducing sugars:** Plant tissue was extracted with hot 80% ethanol; supernatant collected and evaporated on water bath. The residue was dissolved in water and reducing sugar content was estimated spectrophotometrically at 620 nm by Nelson-Somogyi’s method.\(^9\)

**Non-reducing sugars:** Plant material was extracted with hot ethanol and the supernatant was collected to evaporate on water bath. The residue was dissolved in distilled water and incubated for 30 min. by adding

![Plate 1 (a-d)—*Mucuna utilis* Wall. (a) Habit, (b) Flower, (c) Pod, (d) Pickle](image)
H₂SO₄, cooled and drop of methyl red indicator was added followed by neutralization with NaOH. To the neutralized sample alkaline copper tartarate reagent was added, kept in a boiling water bath for 10 min., cooled and arsenomolybdate reagent was added and absorbance was read at 620 nm. Standard graph was prepared with glucose and amount of non-reducing sugars present in the sample calculated using formula given below. 

Non-reducing sugar (% mg) =

\[
\frac{\text{Sugar value from graph (µg)}}{\text{Total vol. of extract (10 mL) } \times \frac{1}{\text{Weight of sample (100 mg) } \times 1000}}
\]

**Crude protein:** Fresh tissue was homogenized in chilled TCA and centrifuged at 5000 rpm. Residue was treated with NaOH and filtered. To the filtrate Biurette reagent was added and incubated for 10 min at room temperature. Absorbance was measured at 540 nm ad standard graph was prepared with Bovine’s serum.

**Protein from nitrogen:** Total nitrogen content was determined by using Micro Kjeldahl Method. Protein content was calculated by multiplying the total nitrogen content by factor 6.25.

**Crude fat:** Dry powder (5 g) was taken in thimble and extracted in preweighed flask by Soxhlet extractor with Petroleum ether for 16 h. Flask was detached from apparatus and extract was evaporated on water bath. Increase in weight of flask gave the fat content.

**Lipid:** Lipids were extracted by using Bligh and Dyer method.

**Ascorbic acid (Vitamin C):** Sample extracted with oxalic acid and dehydrogenated by bromination and then treated with 2, 4 dinitrophenyl hydrazine to form osazone which was dissolved in Sulphuric acid to give an orange-red colour solution which is measured at 540 nm.

**Carotenoids (Pro–Vitamin A):** Tissue was extracted with distilled methanol and extract was partitioned with ether; ether layer separated and evaporated to dryness on water bath. Residue dissolved in ethanol. Lipids and chlorophyll were removed by KOH and kept in a dark at room temperature overnight. Equal volume of water was added to partition the ether layer. Ether layer was collected, evaporated to dryness and residue was dissolved in ethanol then absorbance was measured at 420 nm.

**Vitamin A:** The value of vitamin A was calculated by assuming 0.6 µg of carotene equivalent to 1IU of vitamin A.

**Retinol:** The value of retinol µg per 100 g was estimated by taking into consideration that one International Unit of vitamin A is equivalent to 0.3 µg of retinol.

**Lycopene:** The lycopene content was determined following Ranganna (1976).

**Anthocyanin:** Fresh tissue was homogenized in alcohol and centrifuged. Alcohol extract was treated with HCl in aqueous methanol followed by addition of Anthocyanin reagent. Incubated for 15 min. in dark and absorbance was read at 525 nm. Anthocyanin content was expressed as A₅₂₃ values.

**Chlorophyll:** Fresh tissue was extracted with chilled 80% acetone. The solution was centrifuged, supernatant collected and volume was made 100 mL with acetone. Total chlorophyll content was measured spectrophotometrically (at 645 nm, 652 nm and 663 nm).

**Phenol:** Plant material was extracted in 10 mL methanolic HCl. Supernatant evaporated to dryness on water bath and the residue was dissolved in distilled water, volume made to 7 mL; 0.5 mL Folin-Phenol reagent added and allowed to stand for 3 minutes. 1 mL of 35% sodium carbonate was added and again allowed to stand for one hour. Absorbance read at 630 nm (Standard used caffic acid).

**Food energy:** Food energy was calculated from the content of the proximate principles assuming that proteins, carbohydrates and fats yield 4, 4 and 9 K cals/g, respectively.

**Quantitative mineral analysis:** About 0.5 g of finely powdered sample of each fruit was digested following wet digestion procedures using conc. HNO₃. Digested samples were used for elemental analysis. Sodium (Na), potassium (K) and calcium (Ca) determined using Flame photometer and iron (Fe) and phosphorus (P) spectrophotometrically.

**Qualitative mineral analysis:** Minerals were detected by Johanson (1940) method.

**Bioactive compounds:** Presence of different bioactive molecules was detected using standard simple screening methods.
Results and Discussion

Nutrient values were obtained per 100 g fresh as well as dry weight of pods tissue (Table 1). Pods were found to be rich in crude fiber, lipids, vitamins and antioxidants. Minerals form an important part of nutrition which was estimated in terms of ash yield. Ash analysis of pods was done both qualitatively and quantitatively (Table 2).

Qualitative mineral analysis showed the presence of phosphorus, sodium, calcium, potassium, iron, sulphur and chloride. Potassium, sulphur and chloride found in good concentration whereas potassium was found to be highest (1659 mg) followed by calcium (617 mg) and sodium (138 mg) per 100 g dry weight.

Screening for bioactive molecules exhibited encouraging results. Presence of anthraquinones, flavonoids, leucoanthocyanin, hydroquinone, catechol, saponin and polyoses imparts medicinal potential to the plant. Gopalan et al (2004) have published nutritive values of some common Indian foods. To understand the nutritional status of M. utilis pods studied here and leaves studied by earlier authors, the nutritive values of M. utilis were compared with the values available for two leguminous pods, viz. Cyamopsis tetragonoloba (L.) Taub. and Vicia faba L. commonly used in Indian diet and leaves (Table 3).

M. utilis pods have higher crude fibre, fat, vitamin C, β-carotene, total minerals, calcium, sodium and iron than C. tetragonoloba and V. faba. Pods of M. utilis showed higher content of iron which is five

<p>| Table 1—Nutrients per 100 g tissue of Mucuna utilis pods |</p>
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Nutrients</th>
<th>Fresh weight</th>
<th>Dry weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Moisture content</td>
<td>58.77%</td>
<td>--</td>
</tr>
<tr>
<td>2</td>
<td>Mineral content in terms of Ash yield</td>
<td>---</td>
<td>7.72 g</td>
</tr>
<tr>
<td>3</td>
<td>Crude fiber</td>
<td>4.74 g</td>
<td>11.5 g</td>
</tr>
<tr>
<td>4</td>
<td>Carbohydrate</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Total carbohydrate</td>
<td>0.74 g</td>
<td>1.794 g</td>
</tr>
<tr>
<td></td>
<td>b. Starch</td>
<td>0.211 g</td>
<td>0.513 mg</td>
</tr>
<tr>
<td></td>
<td>c. Reducing sugars</td>
<td>0.179 g</td>
<td>0.435 g</td>
</tr>
<tr>
<td></td>
<td>d. Non-reducing sugars</td>
<td>0.350 g</td>
<td>0.850 g</td>
</tr>
<tr>
<td>5</td>
<td>Crude Protein</td>
<td>1.175 g</td>
<td>2.849 g</td>
</tr>
<tr>
<td>6</td>
<td>Protein (N × 6.25)*</td>
<td>3.33 mg</td>
<td>8.14 mg</td>
</tr>
<tr>
<td>7</td>
<td>Crude fat</td>
<td>1.74 g</td>
<td>4.24 g</td>
</tr>
<tr>
<td>8</td>
<td>Lipids</td>
<td>2.72 g</td>
<td>6.59 g</td>
</tr>
<tr>
<td>9</td>
<td>Vitamins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Ascorbic acid (Vitamin C)</td>
<td>133 mg</td>
<td>322 mg</td>
</tr>
<tr>
<td></td>
<td>b. Carotenoids (pro vitamin A)</td>
<td>205 mg</td>
<td>497 mg</td>
</tr>
<tr>
<td></td>
<td>c. Vitamin A</td>
<td>341666.6 IU</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>d. Retinol</td>
<td>0.102 g</td>
<td>0.247 g</td>
</tr>
<tr>
<td>10</td>
<td>Antioxidants</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Lycopene</td>
<td>0.137 mg</td>
<td>0.332 mg</td>
</tr>
<tr>
<td></td>
<td>b. Anthocyanin</td>
<td>0.249 mg</td>
<td>0.603 mg</td>
</tr>
<tr>
<td></td>
<td>c. Chlorophyll</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>i) Chlorophyll-a</td>
<td>2.38 mg</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>ii) Chlorophyll-b</td>
<td>0.87 mg</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>iii) Total Chlorophyll</td>
<td>3.25 mg</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>d. Phenols</td>
<td>0.111 g</td>
<td>0.270 gm</td>
</tr>
<tr>
<td>10</td>
<td>Food energy K cal</td>
<td>23.39</td>
<td>56.732</td>
</tr>
</tbody>
</table>
times more than *C. tetragonoloba* which supports the traditional belief that pods are blood boosters and tonic. The RDA (Recommended Daily Allowance) of iron varies for different age groups, maximum being for pregnant women i.e. 27 mg per day. This need can be easily fulfilled by including *M. utilis* pods in diet. Protein, carbohydrate and vitamin C content of *M. utilis* leaves are also more. There is great difference between values of crude protein and protein obtained from nitrogen content (N \* 6.25). Wee and Yeoh (1994) have clearly shown that multiplication factor (6.25) does not give correct protein value, as it is calculated for leguminous seeds. They derived multiplication factor estimating proteins from amino acid data and found it to vary from 3.28 to 5.16. Though the present species is leguminous, young pods were utilized by removing the seeds.

High fibre content will help to reduce the risk of heart diseases and other gastrointestinal disorders including the risk of colon cancer. Ascorbic acid i.e. vitamin C and vitamin A are essential for human health, deficiency of which leads to many diseases. *M. utilis* pods are the best source of vitamin C with content as high as 133 mg/100 g. Ascorbic acid is essential to prevent diseases associated with connective tissue and to improve the immune functions. High vitamin A content can be used to alleviate symptoms of vitamin A deficiency which is serious especially in Asia and Africa.

Calcium and sodium contents are also higher in pods. Cellular calcium concentrations are very important for blood coagulation but lack of calcium or phosphorus causes rickets. Flavonoids and simple phenolics like hydroquinone and catechol are reported to possess a wide spectrum of biochemical activities such as antioxidant, antimutagenic and anticarcinogenic, as well as ability to modify the gene expression. Saponins have also been shown to have hypocholesterolemic and anticarcinogenic effects.

Ujowundu et al (2010) have recommended *M. utilis* leaves as a source of important minerals and nutrients; however, they have reported tannins and cyanogenic glycosides from leaves which are antinutrient. They were found to be absent in the pods. Thus pods prove to be safer than the leaves as dietary component.

**Conclusion**

All these observations show that if *M. utilis* pods are utilized as salad, vegetable or pickle can provide nutritional as well as medicinal health benefits. From the present study it can be concluded that pods of this species are good source of primary nutrients, minerals, especially iron and phytochemicals which are essential in normal functioning of body and can become a healthy additional food supplement.

**Acknowledgements**

Authors are thankful to Director, Govt. Vidarbha Institute of Science and Humanities, Amravati (M.S., India) for providing necessary laboratory facilities and to the tribals of North Maharashtra for sharing their knowledge.
References
34. Okaka JC and Okaka ANO, Food composition, Spoilage and shelf life extension, Ocjarco, Academic Publisher Enugu Nigeria, 2001, 54-56.