



# Could the Three Be Edible and Natural Sources of Levodopa? Morphological Characterization of Three Taxa of *Mucuna* (Fabaceae) in Ebonyi State, Southeastern Nigeria

O.E. Nwankwo, S.A. Odewo, B.A. Ajani, L.T. Soyewo, M.S. Nwefuru

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## ABSTRACT

**Background:** There were reports that *M. pruriens* was edible and natural source of Levodopa used in the treatment of Parkinson's disease, but the identity of the variety used for the treatment is uncertain. Hence, the present study is important to provide their diagnostic characters for further studies by prospective researchers.

**Methods:** The qualitative study was carried out by observing and recording the features of the taxa while the quantitative was obtained as the leaflet length and width were measured using a metre rule. From each specimen, leaves were randomly selected and measured using metre rule. Standard methods were used in this study.

**Result:** The three taxa possess trifoliate leaves in common and the flower colours are as follows: Yellow in *M. flagellipes*, purple in *M. pruriens* var. *pruriens* and white in *M. pruriens* var. *utilis*. Testa colours are black, black and white in the *M. flagellipes*, *M. pruriens* var. *pruriens* and *M. pruriens* var. *utilis*, respectively. The highest average leaflet length was 17.5 recorded in *M. pruriens* var. *pruriens* while the lowest average leaflet length of 8.4 was recorded in *M. pruriens* var. *utilis*. The three taxa could be eaten based on review. Petal and testa colour could be used to distinguish the taxa studied.

**Key words:** Diagnostic characters, Edible, Levodopa, Morphological characterization, Petal, Testa, Variety.

## INTRODUCTION

Species of *Mucuna* Adans are legumes in the tribe phaseoleae (Natarajan *et al.*, 2012). The species are climbing vines and erect shrubs distributed worldwide. According to Natarajan *et al.* (2012) the genus *Mucuna* contains about 120 species while De Moura *et al.* (2016) reported 115 species in the genus distributed world-wide with 19 species occurring in Africa. It is native to India and China and has the character of high diseases resistance and grows well in dry soil with low fertility condition (Ravishankar *et al.*, 2016). They possess mainly trifoliate leaves (De Moura *et al.*, 2016). *Mucuna* flowers show a remarkable variation in colour of the corolla, ranging from white (*M. pruriens*) to black (Tozzi *et al.*, 2005). Based on fruit and seed morphology, two subgenera which are *Mucuna* subg. *Mucuna* and *Mucuna* subg. *Stizolobium* (P. Browne) Baker have been traditionally recognized in *Mucuna* (Wilmot-Dear, 1984). Most of the *Mucuna* species have wide economic importance in agriculture as forage and green manure, weed biological control and as a coffee substitute (Ravishankar *et al.*, 2016). Ukachukwu and Obioha (2000) reported that rural population of Nigeria consume seeds of *Mucuna cochinchinensis* during scarcity of common legumes. Osei-Bonsu *et al.* (1996) also reported that *M. cochinchinensis* and *M. utilis* are used as soup thickeners in Southern Ghana as the soup is eaten along with starchy food. Seeds of *Mucuna urens* are used as soup thickener and vegetable oil by Igbo community of Southeastern Nigeria (Afolabi *et al.*, 1985; Ukachukwu

Department of Applied Biology, Ebonyi State University, Abakaliki Nigeria.

**Corresponding Author:** O.E. Nwankwo, Department of Applied Biology, Ebonyi State University, Abakaliki Nigeria.  
Email: ephraimnwankwo8@gmail.com

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*et al.*, 2002). Seeds of *M. sloanei* and *M. flagellipes* Hook.f. are cracked by hitting with a hard object before cooking, then hulled, ground, mixed with red palm oil to obtain yellow powder and marketed as soup thickener (Ezueh, 1997). Consumption of *Mucuna* as food has also been reported from Mozambique and Malawi (Infante *et al.*, 1990; Gilbert, 2002). According to Adebawale and Lawai (2005) and Ezeagu *et al.* (2003), *Mucuna* species generally have high protein content of 24% to 1.44%, lipids ranging from 2.86% to 9.8%, crude fibre (5.3-1.5%), ash (2.9-5.5%) and carbohydrate ranging from 59.2% to 64.88%. The anti-nutritional factors found in *Mucuna* species include L-dopa, phenolics, tannin, haemagglutinins, trypsin and chymotrypsin inhibitors, phytic acid, saponins and cyanogenic compounds (Vadivel and Janardhanan, 2000). However, most of these anti-nutritional factors are eliminated

to low levels during processing. Ukachukwu and Obioha (1997) reported detoxification by cooking for 90 minutes or toasting for 60 minutes. The studies of Ravishankar, *et al.* (2016) on genetic relationship of *M. macrocarpa*, *M. imbricata* and two hybrids named as IIHR hybrid and Dhanwantari showed that *M. macrocarpa* was genetically close to *M. atropurpurea* and *M. gigantea* whereas *M. imbricata* and hybrids IIHR hybrid and Dhanwantari were genetically more close to two varieties of *M. pruriens* which are var. *pruriens* and var. *hirsuta*.

*Mucuna pruriens* (L.) DC. is commonly known as 'Velvet bean'. It is native to Africa and Asia with a vigorous climbing habit. The velvet bean has long, slender branches, alternate leaf arrangement, lanceolate leaf shape; and white flowers with a bluish-purple butterfly-shaped corolla. The pods of *M. pruriens* are pubescent and contain 4 to 6 seeds (Lampariello *et al.*, 2012). There are varieties of *M. pruriens* which are var. *pruriens* and var. *utilis*. *Mucuna pruriens* is by far the most investigated species for the study of intra species genetic and chemo-diversity. *Mucuna pruriens* is the source of an established herbal drug used for the management of Parkinson's disease, male infertility, nervous disorders and also as an aphrodisiac. It has been shown that its seeds are of high medicinal importance (Lampariello *et al.*, 2012). It is the natural source of levodopa in large amounts used mostly for the treatment of Parkinson's disease (Maldonado, 2018).

Agharkar (1991) and Singh *et al.* (1996) reported that *M. pruriens* is a constituent of more than two hundred indigenous drug formulations. It is widespread and common in bushes and low forests areas of India. All parts of *M. pruriens* are important for medicine (Pandey, 1999). *Mucuna pruriens* roots are bitter, thermogenic, anthelmintic, diuretic, emollient, stimulant, aphrodisiac, purgative, febrifuge, tonic, *etc.* It is considered useful to relieve constipation, nephropathy, strangury, dysmenorrhoea, amenorrhoea, elephantiasis, dropsy, neuropathy, consumption, ulcers, helminthiasis, fever and delirium (Shalini, 1997; Upadhyay, 2000). Leaves are popular culinary herbs and fodder crops which are useful in the treatment of ulcers, inflammation, cephalagia and general debility. The trichomes of *Mucuna* pods contain mucuna in and serotonin and as a result, pod causes itching, blisters, and dermatitis. Pods are also used as vegetable and pod hairs (trichomes) are used as anthelmintic. Hairs mixed with honey have been used as vermifuge. As ointment prepared with hairs act as a local stimulant and mild vesicant (Shastri, 1995). Besides, medicinal properties, *Mucuna* fixes nitrogen and is as a green manure and cover crop. Seeds contain L-DOPA (4-3, 4-dihydroxy phenylalanine), glutathione, lecithin, gallic acid, glycosides, nicotine, prurenine, prurenidine, dark brown viscous oil. Demand for *M. pruriens* increased in Asian drug markets and internationally after the discovery that *Mucuna* seeds contain L-dopa, an anti-parkinson's disease drug (Farooqi, 1999). Ravishankar *et al.* (2016) stated that there was paucity of information on phylogeny with high degree

of taxonomical confusion in the genus *Mucuna*. Besides, it is uncertain which variety of *M. pruriens* is the source of natural Levodopa used in the treatment of Parkinson's disease.

### Cultivated varieties of *M. pruriens*

There are four cultivated varieties *Mucuna pruriens* which are: *M. pruriens* var. *pruriens*, *M. pruriens* var. *hirsuta* (Wight and Arn.) Wilmot-Dear, *M. pruriens* var. *sericophylla* (Perkins) Wilmot-Dear, *M. pruriens* var. *utilis* (Wall. ex Wight) Baker ex Burck (Buckles, 1995; [https://www.tropicalforages.info/pdf/mucuna\\_pruriens.pdf](https://www.tropicalforages.info/pdf/mucuna_pruriens.pdf)). These varieties are distributed worldwide. The commonest among all varieties are var. *pruriens* and var. *utilis* (Eilitta *et al.*, 2003). The basionym *M. pruriens* var. *utilis* has other nomenclature based on the perceptions of other authors. Some synonyms of *M. pruriens* var. *utilis* are: *Carpopogon capitatus* Roxb, *Macranthus cochinchinensis* Lour, *Mucuna aterrima* Holland, *Mucuna pruriens* var. *biflora* Trimen, *Mucuna deeringiana* (Bort) Merr (Eilitta *et al.*, 2003). Fruits of *Mucuna pruriens* var. *utilis* have long pale silky hairs with seeds often streaked in different colours while fruits of *Mucuna pruriens* var. *pruriens* have orange-brown irritant bristles with seeds uniform in colour (Carsky *et al.*, 1998).

*Mucuna flagellipes* is a legume popularly known as 'ukpo' by the Igbo-speaking people of Southeastern Nigeria (Enwere, 1998). It possesses pods containing 1 to 3 seeds with a hard coating which is white when immature and turns black when mature and dry (Enwere, 1998). *Mucuna flagellipes* is a liana of high economic importance (Ezueh, 1997). It is very useful in Southeastern Nigeria as a soup thickener. Using the seeds involves cracking, boiling, deshelling and grinding the seeds to powder before adding to thicken the soup. In some villages, the seeds are special delicacy. The cracked seeds are spiced to taste and served as a delicious meal. (Ezueh 1997; Eneobong and Corovale, 1992). The seed flour of *M. flagellipes* is used as soup thickener in most Igbo-speaking communities of Southeastern Nigeria. Preparation of the seed is usually associated with long cooking time which is required to soften the cotyledon before grinding as well as reduce the anti-nutritional components of the seed (Onuegbu *et al.*, 2003).

### Toxicity of the *Mucuna* grains

*Mucuna* grains can be toxic for human and non-ruminant animals if consumed when the anti-nutritive substances in them are untreated. The most important toxic compounds are the non-protein amino acids, L-dopa and hallucinogenic tryptamines. Grain treatment has best been done by boiling in water for one hour, pressure-cooking for 20 minutes, or boiling in water for 30 minutes after soaking in water for 48 hours. Despite the presence of anti-nutritional compounds however, there is evidence that velvet bean grains can be fed to ruminant animals to supplement their diet without apparent problems ([https://www.tropicalforages.info/pdf/mucuna\\_pruriens.pdf](https://www.tropicalforages.info/pdf/mucuna_pruriens.pdf); Onuegbu *et al.*, 2003).

## MATERIALS AND METHODS

Fresh specimens of *M. flagellipes* *M. pruriens* var. *pruriens* and *M. pruriens* var. *utilis* were collected from different locations in Southeastern Nigeria and identified in Ebonyi State University Herbarium, Abakaliki, Nigeria. The voucher numbers are: EBS-H-0231, EBS-H-0232 and EBS-H-0233 respectively. The qualitative and quantitative characters of the taxa were studied following the method used by Nwankwo and Ayodele (2017). The qualitative study was carried out by observing and recording the features of the taxa while the quantitative was obtained as the leaflet length and width were measured using a metre rule. From each specimen, leaves were randomly selected and measured using metre rule.

## RESULTS AND DISCUSSION

The results of this study showed that the taxa possess trifoliate leaves and tubular flower shape in common. The flower colours are yellow in *M. flagellipes*, purple in *M. pruriens* var. *pruriens* and white in *M. pruriens* var. *utilis*. Testa colours are black in *M. flagellipes* and *M. pruriens* var. *pruriens* while in *M. pruriens* var. *utilis* it is white. The leaflet length of the taxa are 6.4(9.5±0.20)11.2, 13.0(17.5±0.1)24.1 and 9.0(8.4±0.1)13.2 in *M. flagellipes*, *M. pruriens* var. *pruriens* and *M. pruriens* var. *utilis*, respectively. The highest average leaflet width of 12.3 was recorded in *M. pruriens* var. *pruriens* while the lowest average width 4.9 in *M. flagellipes*. The result is summarized in Table 1 and 2 while the photographs of the taxa are shown in Fig 1.

*Mucuna flagellipes* is closely related to *M. pruriens* var. *utilis* considering the leaflet size, though, it is cultivated. The three taxa are closely related in their leaflet shape, surface and arrangement which are deltoid, glabrous and alternate respectively (Tables 1 and 2). There were striking differences on the testa colour and petals of the three taxa. The testa colour as stated on the Table 1 and shown in Fig 1, may be a result of their genetic make-up, environment and anthocyanin in the taxa. Our findings disagree with the report of Lampariello *et al.* (2012) that the velvet bean has long, slender branches; alternate, lanceolate leaves; and white flowers with a bluish-purple, butterfly-shaped

corolla. Its pods are pubescent. The disagreement in our reports may be as a result of environmental factors at the locations of our studies. This study has unveiled characteristics of the three taxa of *Mucuna* for prospective researchers to really ascertain the main source of the natural levodopa. It can be concluded that, morphological characters primarily important in *Mucuna* taxonomy.

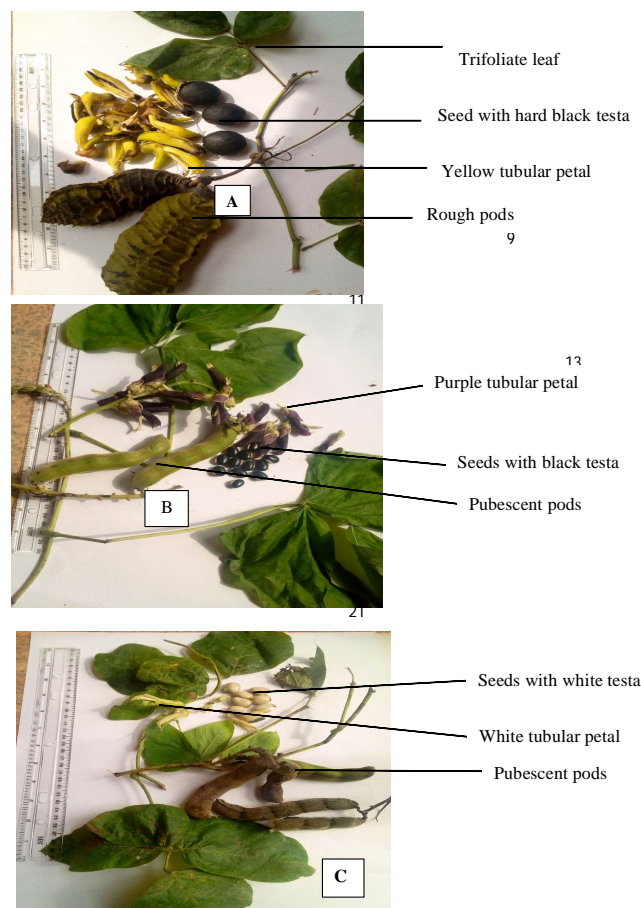


Fig 1: Photographs of the three taxa of *Mucuna*.

A: *M. flagellipes*.

B: *M. pruriens* var. *pruriens*.

C: *M. pruriens* var. *utilis*.

Table 1: Qualitative morphological characters of the three taxa of *Mucuna*.

Character	Leaflet type	Leaflet shape	Leaflet margin	Leaflet apex	Leaflet base	Leaflet surface	Petal colour	Testa colour	Pod surface
<i>M. flagellipes</i>	Trifoliate	Deltoid	Entire	Acute	Truncate	Glabrous	Yellow	Black	Rough
<i>M. pruriens</i> var. <i>pruriens</i>	Trifoliate	Deltoid	Entire	Acute	Oblique	Glabrous	Purple	Black	Pubescent
<i>M. pruriens</i> var. <i>utilis</i>	Trifoliate	Deltoid	Entire	Acute	Truncate	Glabrous	White	White	Pubescent

Table 2: Quantitative morphological characters of the three taxa of *Mucuna*.

	Leaf length (cm)		Leaf width (cm)		Internode length (cm)		Petiole length (cm)	
<i>M. flagellipes</i>	6.4 (9.5±0.20)	11.2	4.1 (6.8±1.1)	8.3	12.0 (10.2±0.2)	18.2	7.1 (9.8±1.1)	12.3
<i>M. pruriens</i> var. <i>pruriens</i>	13.0 (17.5±0.1)	24.1	10.8 (12.3±0.4)	14.2	15.3 (13.9±0.2)	22.4	10.1 (12.8±0.1)	16.3
<i>M. pruriens</i> var. <i>utilis</i>	9.0 (8.4±0.1)	13.2	3.0 (4.9±0.2)	9.2	10.4 (11.9±0.2)	14.0	8.0 (7.3±0.1)	9.3



## CONCLUSION

The similarities in the structures of the taxa showed that they are related to be in the same genus while few differences among them show their existence as a distinct species. Petal and testa colour could be used to distinguish three taxa studied. The three taxa studied are edible when they are well treated. There is a need to properly identify the species and varieties of *Mucuna* before carrying out research on them.

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