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Comprehensive Biochemical and Phytochemical Evaluation of Nutrients and Pharmacologically Active Compounds in *Mucuna pruriens* Leaves

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ABSTRACT

Natural products from plants have long been used for medicine. This study evaluated nutrients and bioactive compounds in an ethanol leaf extract of *Mucuna pruriens*. Leaves collected at Awka, Anambra State, were authenticated, air-dried, powdered and extracted in 90% ethanol. Proximate, vitamin, mineral and phytochemical contents were determined by AOAC methods. Carbohydrate was 59.38%, crude protein 11.92%, fibre 11.90%, moisture 10.12%, ash 4.19% and fat 2.49%. Vitamin C was 60.77 mg/100 g, vitamin A 52.06 mg/100 g and vitamin E 31.30 mg/100 g. Potassium was the dominant mineral (720.65 mg/100 g), followed by sodium (164.04 mg/100 g) and phosphorus (102.32 mg/100 g). Flavonoids were the leading phytochemical (28.74 mg/100 g), followed by alkaloids (11.45 mg/100 g). The profile supports traditional use and nutraceutical interest. The source stated significance at $P < 0.05$, but the methods supplied do not describe replication or the statistical test.

Keywords: *Mucuna pruriens*; nutraceutical; proximate composition; vitamins; minerals; phytochemicals

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1. Introduction

Medicinal plants are those used to alleviate or cure disease, with a traditional place as remedies in a community [10]. They have been used across cultures to flavour and preserve food and to treat illness [11]. Safety, quality and efficacy of herbal products are now a concern in both industrialised and developing countries [33]. Knowledge of healing properties has passed within and between communities. Secondary metabolites usually account for the biological effects of plants used against infectious disease [24]. Reports of antimicrobial resistance have increased interest in plant products that may limit microbial growth, alone or with conventional agents [10,11].

More than 3.3 billion people in less developed countries are reported to use medicinal plants regularly [33]. Tannins, terpenoids, alkaloids and flavonoids are among the constituents linked to therapeutic, including antimicrobial, activity [24]. Flavonoids and tannins have been reported active against *Bacillus cereus*, *Staphylococcus aureus* and other bacteria. Tannins are also cited in antiseptic soaps used on skin [29]. Phytochemicals can be toxic to filamentous fungi, yeasts and bacteria, and inhibitory to viral reverse transcriptase. Saponins have been described as antifungal secondary metabolites, and saponins, steroids, phenols and tannins may contribute to antimicrobial action [29].

2. Literature review

Mucuna, Fabaceae, subfamily Papilionaceae, includes about 150 annual and perennial legumes. Velvet bean, *M. pruriens*, is widespread in tropical and subtropical regions [30]. Seed protein of 23–35%, with digestibility comparable to soybean, rice bean and lima bean, has led to its use as food [6]. Cultivated types differ in pod pubescence, seed colour and days to harvest. “Cowitch” and “cowhage” name forms with long stinging hairs on the pod [30].

2.1 Phytochemical constituents

M. pruriens is known for L-DOPA (levodopa), a dopamine precursor, and for serotonin [6]. Seeds produce the non-protein amino acid 3-(3,4-dihydroxyphenyl)-L-alanine (L-DOPA), which is thought to account for much of the toxicity of the seed [11]. Glutathione, lecithin, gallic acid and beta-sitosterol are also reported. Pods, seeds, leaves and roots contain indole-3-alkylamines, including N,N-dimethyltryptamine. Leaves contain 6-methoxyharman; serotonin is reported in pods. Seed oil includes stearic, oleic, linoleic and palmitic acids [30]. Whole pods may contain up to 4% L-DOPA, declining with maturity, and the seed holds the highest concentration [30].

Alkaloids including mucunine and mucunadine have been linked to antiparasitic, anti-inflammatory and neuroprotective effects. Flavonoids, phenolics and tannins contribute antioxidant activity. Seeds are rich in protein, essential amino acids and fatty acids [6]. These constituents underlie interest in the plant as an anti-parkinsonian agent, aphrodisiac, nervine and antioxidant. A source figure of principal metabolites, captioned from Sathiyarayanan and Arulmozhi (2007) and mislabelled *Mucuna purines*, was an external diagram and is not reproduced here.

3. Materials and methods

3.1 Collection and authentication

M. pruriens leaves were collected at Awka, Awka South Local Government Area, Anambra State. The sample was identified by Prof. Catherine V. Nnamani, Department of Applied Biology, Ebonyi State University, Abakaliki.

3.2 Extraction

Leaves were washed, air-dried at room temperature for two weeks and ground. Powder (400 g) was soaked in 1,000 mL of 90% ethanol for 48 hours, with stirring every 8 hours. The mixture was filtered through Whatman No. 1 paper. The filtrate was evaporated on a rotary evaporator at 30 °C for 10 minutes and stored airtight under refrigeration [21]. The source text printed the evaporation temperature as 300 °C; 30 °C is used here as the only temperature compatible with a 10-minute rotary evaporation of ethanol.

3.3 Chemical analysis

Proximate, mineral, vitamin and phytochemical contents were determined by AOAC methods [4]. Replication, number of determinations and the statistical test behind the stated $P < 0.05$ were not described.

4. Results

The source file contained four Prism chart objects (proximate, vitamin, mineral and phytochemical compositions). Those objects did not yield extractable data series. The values below are those stated in the abstract and are the results of record. Proximate components sum to 100.00%.

Table 1. Proximate composition of *M. pruriens* leaf extract

Component	Content (%)
Carbohydrate	59.38
Crude protein	11.92
Fibre	11.90
Moisture	10.12
Ash	4.19
Fat	2.49

Table 2. Vitamin composition of *M. pruriens* leaf extract

Vitamin	Content (mg/100 g)
Vitamin C	60.77
Vitamin A	52.06
Vitamin E	31.30
Vitamin B1	27.48
Vitamin B2	18.01

Vitamin	Content (mg/100 g)
Vitamin B3	3.74

Table 3. Mineral composition of *M. pruriens* leaf extract

Mineral	Content (mg/100 g)
Potassium	720.65
Sodium	164.04
Phosphorus	102.32
Calcium	41.20
Iron	9.40
Magnesium	7.14
Zinc	5.89
Manganese	1.91
Copper	1.76

Table 4. Phytochemical composition of *M. pruriens* leaf extract

Phytochemical	Content (mg/100 g)
Flavonoids	28.74
Alkaloids	11.45
Saponins	6.60
Terpenoids	5.28
Tannins	2.55
Phenols	2.26
Steroids	2.03
Cardiac glycosides	1.84
Anthraquinones	1.43

Vitamin B1 was printed as 27.48 mg.100 g in the source; it is reported as 27.48 mg/100 g. The abstract described these levels as significant ($P < 0.05$) without a comparison group or test statistic.

5. Discussion

Carbohydrate was the largest proximate fraction, with useful crude protein and fibre and smaller ash and fat. That profile can supply energy and amino acids for tissue maintenance [22]. The discussion in the source links this pattern to repair of lead-damaged tissue. No lead exposure or animal experiment is described in the methods of this manuscript, so that link is an interpretation, not a result of the analysis.

Vitamins C and A were highest, followed by E, B1 and B2, with B3 lowest. Vitamins A, C and E are antioxidants and vitamin C is required for collagen synthesis. B vitamins support intermediary metabolism. The source extends these roles to protection of testicular tissue against lead acetate. Again, lead and testicular endpoints were not measured here.

Potassium, sodium, phosphorus and calcium led the minerals, with smaller amounts of magnesium, zinc, iron, copper and manganese. Potassium and sodium support ionic balance; calcium is involved in signalling; zinc and magnesium support enzymes and antioxidant defence. Zinc is also required for spermatogenesis. These are established physiological roles, not findings from a fertility assay in this study.

Flavonoids were the most abundant phytochemical, then alkaloids, terpenoids and saponins, with tannins, phenols, cardiac glycosides, anthraquinones and steroids lower. Flavonoids and related phenolics can scavenge radicals and reduce inflammation. The author proposes that this composition offers a biochemical basis for possible effects against male infertility. That proposal is not tested by the proximate, vitamin, mineral and phytochemical data alone. Several works cited in the discussion (Lampariello et al., 2012; Lobo et al., 2010; Aruoma, 2003; Pizzino et al., 2017; Ullah et al., 2020; Khan et al., 2022; Pathania et al., 2020; Aarsland et al., 2017; Misra and Wagner, 2007; Singh et al., 2013; Sathiyarayanan and Arulmozhi, 2007) are not in the reference list supplied with the manuscript.

6. Conclusion

Ethanol extract of *M. pruriens* leaves contained measurable proximate nutrients, vitamins, minerals and phytochemicals. Carbohydrate was the largest proximate fraction. Vitamins C and A exceeded the other vitamins measured. Potassium was the most abundant mineral. Flavonoids were the leading phytochemical. The results support nutritional and nutraceutical interest. Claims about lead toxicity or male infertility require a separate experimental study.

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