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Monograph

Vangueria madagascariensis J.F. Gmelin (Rubiaceae) - an under-utilised African traditional medicinal food plant with potential applications

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Abstract

Vangueria madagascariensis J.F. Gmelin (Rubiaceae) is one of the most common species of the genus *Vangueria* which have received scientific attention for its extensive ethnomedicinal applications worldwide. Generally cultivated for its sweet-sour fruits, this plant has also brought significant contribution in the African *materia medica* for its antimicrobial and anthelmintic properties since time immemorial. *In vitro* data revealed the presence of a number of bio-constituents with pluripotential mechanism of action(s) which might be responsible for its medicinal virtues. Recent findings also support its promising potential for use against inflammatory diseases and as a functional food/dietary adjunct for the management of diabetes mellitus and related complications. The present monograph endeavours to highlight the botanical description, ethnopharmacological uses, and main therapeutic benefits of *Vangueria madagascariensis*. Special emphasis has been geared towards recent *in vitro* data which tend to support its ethnopharmacological use in the traditional medicine of many countries

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GENERAL INFORMATION

Vangueria madagascariensis (VM) J.F. Gmelin, commonly known as Tamarind of the Indies or wild medlar is a perennial plant of the Rubiaceae family which is native to tropical Africa and Madagascar [1]. It grows naturally in riverine-lowland forests and volcanic ash soils throughout Africa and Asia. The plant can also be found in the Republic of Mauritius (including Rodrigues Island), Seychelles, India, Northern Australia, Singapore and Trinidad [2]. The generic name '*Vangueria*' is derived from the Madagascan vernacular name 'voa-vanguier'. Other common vernacular names include Voavanga and Vavandrika in Madagascar; Vavang and Vavangue in Mauritius, Madagascar and Seychelles; and mviru or muiru in Swahili [3-5]. The synonyms for this plant are

Vangueria acutiloba Robyns., *Vangueria edulis* Vahl. and *Vangueria venosa* Hochst. Ex A. Rich. [6].

BOTANICAL DESCRIPTION

VM is a profusely branched tree of 1.5-15 m tall, with smooth grey bark. Leaves, with stalks 5-10 mm long, are opposite, elliptic-ovate or rotundate, dark green above and paler beneath with prominent venation. The plant bears small flowers in clusters which are greenish to yellowish in colour with calyx 1.2-3 mm in length. Fruits are more or less globular, smooth, and shiny with diameter 2.5-5 cm and contain 4-5 pyrenes, varying from green to brownish red. They appear greenish when immature, changing to brownish-red when ripe, and contain 4-5 woody seeds up to 1.6 cm long [7, 8].



Figure1. *Vangueria madagascariensis*, A) leaves, B) unripe fruits, C) seeds and D, E and F) ripe fruits

ETHNOPHARMACOLOGICAL USES

Some species of genus *Vangueria* are widely studied and used in traditional medicine in various countries. For instance, in Tanzania different parts of the species *Vangueria infausta* have traditionally been used for the treatment of malaria, wounds, menstrual and uterine problems [9]. With respect to VM, available folk data suggest its use as an athelmintic against roundworms, as antiplasmodial, as astringent against cholagogue and as expectorant, for the treatment of smallpox and sores, herpes labialis, and ophtalmia [10]. Roots are also reported to be macerated and administered orally for the treatment of diabetes mellitus in South-eastern Sudan [11]. In Mauritius, an infusion of the leaves of VM, ingested once a week, has also been reported for the same purpose whilst a bark decoction is used against dysentery, cardiac palpitations or nausea [12]. In Rodrigues, a decoction made from VM, *Jatropha curcas*, *Toddalia asiatica* and *Sporobolus capensis* is used as mouthwash for teething children. Additionally, a decoction of leaves of VM, *Jatropha curcas*, *Azadirachta indica* and pieces of *Ipomoea pes-caprae* (liana) with a pinch of salt is prepared for bath for treatment of abscesses, scurf, and carbuncle [13].

NUTRITIONAL VALUE

The proximate nutritional composition of the wild medlar per 100g (Table 1) was established based on the pulp to fruit ratio of 47.5% [14].

Table 1. The proximate nutritional composition of the wild medlar per 100g

| Nutrient | Percentage |
|---------------|------------|
| Energy (kJ) | 498 |
| Protein | 1.4 |
| Lipid | 0.1 |
| Carbohydrate | 28 |
| Fibre | 4.7 |
| Vitamins | mg |
| Ascorbic acid | 4.7 |
| Thiamine | 0.04 |
| Riboflavin | 0.03 |
| Niacin | 0.61 |
| Minerals | mg |
| Calcium | 25 |
| Iron | 1.1 |
| Magnesium | 39 |
| Phosphorus | 36.6 |
| Potassium | 521 |
| Sodium | 28 |

SELECTED CONSTITUENTS

Preliminary phytochemical screening of the leaves and stems indicate the presence of alkaloids, terpenes, cyanogenetic heterosides as well as phenols, tannins, and saponosides which may likely be responsible for its documented antimicrobial effects [12]. Interestingly, fractionation and purification of the alcoholic extract of the leaves and stem of VM cultivated in Egypt yielded thirteen compounds identified as: β -sitosterol acetate, stigmasterol, palmitic acid, scopoletin, *p*-coumaric acid, protocatechuic acid, esculetin, ethyl-1-O-glucosyl-4-O-(E) caffeoyl quinate, kaempferol-3-O-rhamnoside, 7-O-rutinoside, β -sitosterol, ceryl alcohol, vanillic acid and β -sitosterol-3-O- β -D-glucopyranoside [15].

BIOLOGICAL ACTIVITIES

The *n*-hexane and *n*-butanol fractions of the leaves and chloroform, *n*-hexane fractions of the stem-bark (400 mg/kg) showed potent anticonvulsant activity against pentylenetetrazole induced convulsion in rats compared with carbamazepine. Different fractions of the leaves and bark (*n*-hexane, chloroform, ethyl acetate) had significant inhibiting effects on Gram-negative bacteria *Escherichia coli*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa* and the fungus *Candida albicans* when compared with positive control Gentamicin (bacteria) and Clotrimazole (fungus) [15]. Potent anti-inflammatory activity compared with indomethacin was observed in rats administered with chloroform and ethyl acetate fractions of the leaves, with maximum effect being obtained after 2 hrs. The activity of the chloroform and ethyl acetate fractions may be attributed to scopoletin which has anti-inflammatory activity. Indeed, scopoletin is a specific inhibitor of the production of inflammatory cytokines in mast cells and may be beneficial in the treatment of chronic inflammatory diseases [16].

RECENT FINDINGS

We recently showed that only leaf decoction ($IC_{50}=1.13\pm0.24$ mg/ml), leaf methanol ($IC_{50}=1.46\pm0.45$ mg/ml), and unripe fruit methanol ($IC_{50}=1.38\pm0.06$ mg/ml) extracts of VM significantly ($p<0.05$) decreased α -amylase activity *in vitro* [17]. Enzyme kinetic studies revealed that VM extracts decreased both the maximal velocity and Michaelis-Menten constant, indicating a mixed non-competitive type of inhibition. Active extracts which were found to inhibit α -glucosidase were unripe fruit methanol ($IC_{50}=0.36\pm0.07$ mg/ml), unripe fruit decoction ($IC_{50}=0.50\pm6.0$ mg/ml), leaf decoction ($IC_{50}=0.61\pm0.21$ mg/ml) and ripe fruit methanol ($IC_{50}=3.28\pm0.45$ mg/ml), where values were

significantly lower than the positive control acarbose ($IC_{50}=5.03\pm0.14$ mg/ml). However, methanol and decoction extracts of the leaves, ripe and unripe fruits and seeds did not significantly retard glucose movement across dialysis tube. Antimicrobial activity was noted for *Escherichia coli* using unripe fruit decoction extract (12.67 ± 0.58 mm) whereas for *Staphylococcus aureus*, leaf methanol extract produced highest inhibition (11.67 ± 1.53 mm). However, the inhibitory zones were significantly lower ($p<0.05$) than the mean standard antibiotic, ampicillin. Decoction and methanol extracts of the leaves, ripe and unripe fruits and seeds did not show antifungal properties. Total phenolic content showed a strong negative correlation with 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity ($r=-0.77$, $p<0.05$) whereas for ferric reducing antioxidant power (FRAP), strong positive relationship was found ($r=0.88$, $p<0.05$). Methanol leaf extract with an $IC_{50}=43.22\pm0.59$ μ g/ml, demonstrated efficient nitric oxide scavenging potential and was significantly ($p<0.05$) lower than the control ascorbic acid ($IC_{50}=546.54\pm9.79$ μ g/ml). Concerning hydroxyl radical scavenging assay, only methanol extracts of leaf ($IC_{50}=0.09\pm0.04$ μ g/ml), unripe fruit ($IC_{50}=0.29\pm0.08$ μ g/ml) and ripe fruit ($IC_{50}=0.26\pm0.02$ μ g/ml) had IC_{50} values significantly lower ($p<0.05$) than α -tocopherol ($IC_{50}=0.50\pm0.11$ μ g/ml) [17].

CONCLUSIONS

This paper has tried to highlight some of the medicinal values of VM validated through different *in vitro* assays. Recent findings showed the promising antioxidant, antimicrobial and anti-diabetic activity of the fruits, seeds and leaves of VM. However, this paper provides essential information for literature only. Further studies are needed to ensure that *in vitro* effects can be translated into a safe and effective use of VM as a functional food and thus validate its folkloric use.

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