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Review

Lawsonia inermis L. (henna): Ethnobotanical, phytochemical and pharmacological aspects

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ABSTRACT

Ethnopharmacological relevance: The use of *Lawsonia inermis* L. (henna) for medicinal and cosmetic purposes is inextricably linked to ancient and modern cultures of North Africa and Asia. Literature and artwork indicates that *Lawsonia inermis* played an important holistic role in the daily lives of some ancient cultures, providing psychological and medicinal benefits, as well as being used for personal adornment. Although henna was historically applied to the hands and feet to protect against fungal pathogens and to hair to combat lice and dandruff, other traditional uses include the treatment of liver and digestive disorders, reduction of tissue loss in leprosy, diabetic foot disorders and ulcers.

Phytochemistry: Almost 70 phenolic compounds have been isolated from various parts of the plant. Naphthaquinones, which include the dying principle lawsone, have been linked to many of the pharmacological activities. The terpene, β-ionone is largely responsible for the pungent odour of the essential oil isolated from the flowers. In addition to other volatile terpenes, some non-volatile terpenoids, a single sterol, two alkaloids and two dioxin derivatives have also been isolated from the plant.

Bioactivity: Henna is a pharmacologically important plant with significant *in vitro* and *in vivo* biological activities. Although a myriad of pharmacological activities have been documented, the antioxidant and antimicrobial activities are the most thoroughly investigated. Some incidents of adverse reactions following application to the skin have been reported, but these are mainly confined to cases involving individuals with glucose-6-phosphate dehydrogenase deficiency and reactions to adulterants added to henna products.

Conclusions: Adulteration of henna is very common and may have resulted in unwarranted scientific findings. Phytochemical profiling studies of the plant, which are crucial for the establishment of proper quality control protocols, are lacking and hamper the development of medicinal products. Although many *in vitro* studies have been conducted to evaluate the pharmacological activities and many *in vivo* studies have focussed on the toxicity of extracts, more *in vivo* studies to validate pharmacological activities are needed. The roles of specific compounds and their synergies have not been comprehensively investigated.

Contents

Abbreviations: ABTS, [2,2′-azino-bis(3-ethyl benzthiazoline-6-sulfonic acid)]; BHT, Butylated hydroxy toluene; b.w., Body weight; CNS, Central nervous system; DMBA, 7,12-dimethylbenz(a)anthracene; DPPH, 1,1-diphenyl-2-picryl hydrazyl; EC, effective concentration; FTC, Ferric thiocyanate; G6PD, Glucose-6-phosphate dehydrogenase; IC_{50}, Half maximal inhibitory concentration; IZD, Inhibition zone diameter; LDH, Lactose dehydrogenase; MBC, Minimum bacterial count; MIC, Minimum inhibitory concentration; *p.o.*, *Per os*; PPD, Paraphenylenediamine; RBC, Red blood cell; SGOT, Glutamate oxaloacetate transaminase; SGPT, Serum glutamate pyruvate transaminase; TBA, Thiobarbituric acid; WBC, White blood cell

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1. Introduction

Lawsonia inermis L. (synonym *Lawsonia alba*), commonly referred to as henna, belongs to the Lythraceae family and is the sole species in the genus. It has the appearance of a small shrub-like tree, 2–6 m in height, with spine-tipped branchlets. The leaves (Fig. 1a) are described as smooth, opposite, sub-sessile, elliptically-shaped and broadly lanceolate, with depressed veins clearly visible on the dorsal surface (Kumar et al., 2005). Henna flowers comprise four sepals, a 2 mm calyx tube, with white or red stamens present as pairs on the perimeter of the calyx tube, and obvate, "crumbled" petals (Chaudhary et al., 2010). The ovary is four-celled, with an erect style. The tree produces small, brown fruits containing 32–49 angular seeds (Kumar et al., 2005).

This taxonomic description of *Lawsonia inermis* contrives a rather lackluster image, and in no way reflects the inextricable and mystical link between henna and human culture since ancient times. Henna thrives in a semi-arid, frost-free zone, and will withstand prolonged drought and poor soil (Fernández-García et al., 2014). This optimal growing region for henna created both a geographical and cultural frame for its use. Henna has observable benefits to humans, and these benefits are recognized as 'baraka', loosely translated as 'blessedness' or luck. The plant has properties that deter and relieve human discomfort from fungal infections of the skin, lice and sunburn; henna also has analgesic and anti-inflammatory effects on skin. 'Baraka' is the benevolent force that averts the gaze of the 'Evil Eye', the cultural construction of the malevolence and misfortune that causes disease and pain (Dundes, 1992). Henna is culturally contrived to possess powers of blessing and luck, particularly for women, protecting the wearer against the Evil Eye (Westermarck, 1914).

In wild habitat, henna retains green leaves through long dry spells; the lips of browsing animals nibbling the last leaves in their environment are stained red-orange from the lawsone in the henna leaves. Humans may have first noticed henna's characteristic stain when following their grazing and browsing animals, finding a bloody, though harmless colour on their animal's mouths after eating henna leaves. If humans attempted to clear the chewed henna from the animal's mouths, their fingers would have become stained. This 'discovery of henna' probably occurred at different times and in different regions during the warming in the late Holocene, most likely across North Africa where wild henna has considerable genetic variance (Boubaya et al., 2013). Artifacts that definitively prove henna use by humans can be dated

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