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A Call for Bioprospecting: Potential Medical and Agricultural Applications of *Calpurnia aurea* in Ethiopia

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Genetic Resource Access and Benefit Sharing Research LEO

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1. Background

1.1. Ethiopian ABS Laws

Ethiopia is recognized as one of the world's biodiversity-rich countries, possessing enormous genetic resources and associated indigenous knowledge (Bekele, 2007). To ensure sustainable utilization and equitable sharing of benefits arising from genetic resources, Ethiopia established Access and Benefit-Sharing (ABS) laws under Proclamation No. 482/2006 and Regulation No. 169/2009. These laws regulate access to biological resources and associated traditional knowledge while safeguarding the rights of local communities. The Ethiopian Biodiversity Institute (EBI) is responsible for implementing these laws and ensuring that bio-prospecting activities promote conservation, sustainable use, and fair benefit-sharing among stakeholders (Bekele, 2007).

The ABS framework is particularly important in bio-prospecting because many indigenous medicinal plants possess untapped pharmaceutical and veterinary potential. Traditional knowledge associated with these resources has been developed and maintained by local communities for generations (Abebe and Ayehu, 1993). Therefore, commercialization or scientific utilization of such resources should recognize community ownership and ensure equitable compensation.

1.2. Purpose of the Review

This review aims to promote the bio-prospecting potential of *Calpurnia aurea* for the development of natural anti-lice treatments in livestock. The document highlights its biological characteristics, distribution, industrial applications, medicinal significance, and potential risks while emphasizing the importance of Ethiopia's ABS framework in ensuring sustainable and equitable utilization.

1.3. Taxonomy and Classification

- Kingdom: Plantae
- Phylum: Magnoliophyta
- Class: Magnoliopsida
- Order: Fabales

- Family: Fabaceae
- Genus: *Calpurnia*
- Species: *Calpurnia aurea* (Aiton) Benth.

The Fabaceae family is one of the largest flowering plant families and includes numerous medicinally valuable species (Asfaw and Tadesse, 2001). *Calpurnia aurea* is taxonomically important because of its rich phytochemical composition and ethnomedicinal applications (Tadeg et al., 2005).

2. *Calpurnia aurea* Characteristics

2.1. Morphological Characteristics

Calpurnia aurea is an evergreen shrub or small tree reaching 2–6 m in height. The stem is greenish-brown with smooth bark. Leaves are pinnately compound and consist of several oval leaflets. The plant produces attractive bright yellow flowers arranged in racemes. Fruits are flattened pods containing multiple seeds (Mesfin et al., 2009). The leaves possess a characteristic odor when crushed, indicating the presence of volatile bioactive compounds. Seeds are hard-coated and contain significant concentrations of secondary metabolites responsible for pesticidal activities (Tadeg et al., 2005).

2.2. Physiological Traits

The species adapts well to diverse ecological conditions, especially in subtropical and highland regions. It tolerates drought conditions and grows rapidly in disturbed habitats (Asfaw and Tadesse, 2001). Like many members of Fabaceae, the plant contributes to nitrogen fixation through symbiotic association with rhizobia bacteria. The plant reproduces mainly through seeds, though vegetative propagation can also occur. Secondary metabolite production is enhanced under environmental stress conditions, which may increase its medicinal and pesticidal potency (Bekele, 2007).

2.3. Genetic Characteristics

Although molecular studies on *C. aurea* remain limited, phytochemical and genetic investigations indicate considerable diversity among populations. Research has identified genes associated with alkaloid biosynthesis pathways, which may contribute to its insecticidal properties. Phytochemical analyses reveal the presence of quinolizidine alkaloids, flavonoids, terpenoids, and tannins, compounds known for antimicrobial and insecticidal activities (Tadeg et al., 2005). The genetic diversity of Ethiopian populations provides opportunities for selecting elite chemotypes with enhanced anti-parasitic efficacy for pharmaceutical and veterinary applications.

3. Geographical Distribution in Ethiopia

Calpurnia aurea is widely distributed across Ethiopia, particularly within highland and mid-altitude agroecological zones ranging from approximately 1,000 to 3,000 meters above sea level (Asfaw and Tadesse, 2001). The species is commonly found in several regions of the country, including Oromia, Amhara, Sidama, Southern Ethiopia, and Tigray. Its broad ecological adaptability enables it to thrive under diverse environmental conditions, especially in areas characterized by moderate rainfall and well-drained soils. The plant commonly grows along forest margins, riverbanks, grasslands, roadside habitats, and disturbed agricultural lands, demonstrating its strong resilience and capacity to colonize both natural and human-modified ecosystems (Bekele, 2007).

Beyond Ethiopia, *Calpurnia aurea* is also widely distributed in various parts of tropical and southern Africa, including Kenya, Uganda, Tanzania, South Africa, and Eritrea (Asfaw and Tadesse, 2001). Its extensive geographical distribution reflects its ecological versatility and environmental tolerance, making it an important medicinal and multipurpose species across the continent. The widespread occurrence and easy accessibility of the plant have contributed significantly to its long-standing utilization in traditional ethnoveterinary and ethnomedicinal practices, particularly for the management of livestock ectoparasites such as lice and ticks (Teklehaymanot and Giday, 2007).

The adaptability of *C. aurea* to different climatic conditions contributes to its abundance and accessibility for traditional medicinal use. The species survives under varying soil conditions and demonstrates resistance to environmental stresses such as drought and moderate grazing pressure (Asfaw and Tadesse, 2001). Its broad ecological adaptability makes it a suitable candidate for sustainable cultivation and domestication programs aimed at large-scale bio-prospecting and industrial utilization

4. Applications

4.1. Medical Applications

In Ethiopia, traditional veterinary medicine has long utilized *Calpurnia aurea* as an effective remedy for controlling ectoparasitic infestations in livestock (Teklehaymanot and Giday, 2007). Local communities commonly prepare treatments from crushed leaves, powdered seeds, or aqueous extracts, which are directly applied to infected animals to manage lice, ticks, and other external parasites. The widespread ethnoveterinary use of the plant reflects its accessibility, affordability, and perceived effectiveness in rural livestock production systems. In addition to its traditional applications, scientific investigations have increasingly validated the medicinal value of *C. aurea*, revealing its broad spectrum of biological activities, including insecticidal, antimicrobial, antifungal, anti-inflammatory, and anthelmintic properties (Tadeg et al., 2005).

The pesticidal and therapeutic effects of *C. aurea* are largely attributed to the presence of bioactive secondary metabolites such as alkaloids, flavonoids, and saponins, which interfere with the nervous system, metabolism, and physiological functions of parasites (Tadeg et al., 2005). Experimental studies have reported significant mortality rates among ectoparasites exposed to leaf and seed extracts of the plant, further supporting its potential as a natural veterinary treatment. Moreover, the growing resistance of animal lice and other parasites to synthetic insecticides, together with increasing concerns regarding chemical residues in animal products and environmental contamination, has intensified global interest in plant-based alternatives (Yineger et al., 2008). Consequently, *Calpurnia aurea* is increasingly recognized as a promising source of eco-friendly and sustainable veterinary pharmaceuticals for the development of natural anti-lice formulations.

4.2. Agricultural Applications

The plant has potential use as a botanical pesticide in livestock and crop protection systems. Farmers traditionally use leaf extracts to repel insects and manage external parasites (Giday et al., 2009). Plant residues may also contribute to soil fertility improvement because the species belongs to the nitrogen-fixing Fabaceae family.

4.3. Biotechnological Applications

Bioactive compounds isolated from *C. aurea* may serve as lead molecules for the development of novel bio-pesticides and veterinary drugs. Modern biotechnological approaches such as phytochemical extraction, metabolomics, and molecular characterization can support the identification and commercialization of active compounds. The plant may also contribute to green biotechnology through environmentally safe pest management systems (Bekele, 2007).

5. Toxicity Concerns

Despite its significant medicinal and pesticidal potential, *Calpurnia aurea* may pose certain toxicological risks when used improperly or at excessive doses. The seeds and leaves of the plant contain alkaloids and other bioactive compounds that can become toxic to livestock if accidentally ingested in large quantities (Abebe and Ayehu, 1993). Reported adverse effects include gastrointestinal disturbances, nervous system disorders, general body weakness, and other toxic reactions that may negatively affect animal health and productivity. These toxic properties highlight the importance of careful handling and controlled application of plant-derived formulations in veterinary practices.

Although traditional communities have long utilized *C. aurea* safely through indigenous knowledge-based preparations, scientific validation of dosage levels and toxicity thresholds remains essential. Comprehensive toxicological evaluations, pharmacological studies, and dosage standardization are therefore necessary before the plant can be developed into large-scale commercial veterinary pharmaceuticals (Tadeg et al., 2005). Such assessments are crucial to ensure the safety, efficacy, and sustainable utilization of *Calpurnia aurea* as a natural treatment against animal lice and other ectoparasites.

Conclusion

Calpurnia aurea is a highly valuable indigenous medicinal plant with strong potential for the development of natural treatments against animal lice and other ectoparasites. Its widespread traditional use, rich phytochemical composition, ecological adaptability, and demonstrated insecticidal activities make it an excellent candidate for bio-prospecting initiatives. The plant offers promising opportunities for pharmaceutical, agricultural, and biotechnological industries seeking eco-friendly alternatives to synthetic pesticides. However, sustainable utilization, toxicity assessment, and proper implementation of Ethiopia's ABS framework are essential to ensure biodiversity conservation and equitable benefit-sharing.

Researchers, industries, policymakers, and local communities should collaborate to promote scientific validation, sustainable commercialization, and conservation of *Calpurnia aurea*. Such efforts will contribute to improved livestock health, rural livelihoods, biodiversity conservation, and sustainable development in Ethiopia.

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