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ALOE VERA (ALOE BARBADENSIS MILLER): AN ETHNOPHARMACOLOGICAL REVIEW OF ITS PHYTOCHEMISTRY, TRADITIONAL USES, AND THERAPEUTIC POTENTIAL

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Abstract

Ethnopharmacological relevance: *Aloe vera* (*Aloe barbadensis Miller*) is one of the most widely recognized medicinal plants, documented in traditional systems across Asia, Africa, and the Mediterranean. It has been used in Ayurveda, Traditional Chinese Medicine, Unani, and Arabian medicine for skin, gastrointestinal, and systemic disorders.

Aim of the review: To synthesize ethnomedicinal knowledge, phytochemistry, pharmacological activities, and clinical evidence of *Aloe vera* with emphasis on its ethnopharmacological significance and therapeutic potential.

Materials and methods: Literature was collected from PubMed, Scopus, Google Scholar, and ethnopharmacological texts, integrating traditional knowledge with modern pharmacological data.

Results: More than 75 phytoconstituents, including polysaccharides (acemannan, glucomannan), anthraquinones (aloin, emodin), sterols (lupeol, campesterol), enzymes, vitamins, and minerals, have been identified. These contribute to pharmacological activities such as wound healing, anti-inflammatory, antimicrobial, immunomodulatory, and antioxidant effects. Clinical trials support the efficacy of Aloe gel in burns, oral lichen planus, and dental healing, while evidence in psoriasis and diabetes is inconsistent.

Conclusions: *Aloe vera* exemplifies the link between traditional ethnomedicine and modern pharmacology. While ethnomedical claims are validated by preclinical and clinical data, future research must focus on extract standardization, mechanistic studies, and large-scale randomized trials.

Keywords: *Aloe vera, ethnopharmacology, phytochemistry, wound healing, immunomodulation, traditional medicine*

1. Introduction

Ethnopharmacology emphasizes the cultural use of medicinal plants and their validation through pharmacology. *Aloe vera* (*Aloe barbadensis Miller*), a succulent of the family Asphodelaceae, is historically regarded as a "healing plant" across civilizations. It has been documented in Mesopotamian clay tablets (c. 1750 BC), the Egyptian Ebers Papyrus (c. 1550 BC), and in the works of Dioscorides and Pliny in Greco-Roman medicine (Surjushe, Vasani, & Saple, 2008).

In **Ayurveda**, aloe (*Kumari*) is classified as a *Rasayana*, used for gynecological, hepatic, and dermatological disorders (Ghazanfar, 1994). In **TCM**, aloe (*Lu Hui*) is prescribed for constipation, fever, and fungal infections (Hamman, 2008). **Unani medicine** recognizes aloe (*Sibr*) as a laxative, digestive stimulant, and remedy for skin conditions (Surjushe et al., 2008). In **Arabian medicine**, aloe was applied for fever, headaches, and conjunctivitis

(Ghazanfar, 1994). Folk uses across Africa and Latin America include applications in burns, diabetes, hypertension, and infections (Eshun & He, 2004; Hu, Xu, & Hu, 2003).

Today, Aloe-derived products form a multibillion-dollar industry, highlighting the importance of bridging traditional knowledge with modern pharmacology.

2. Botany and Distribution

Aloe vera belongs to genus *Aloe*, family Asphodelaceae. Morphologically, the plant has thick, lanceolate leaves with serrated margins. Internally, the **outer rind** provides structural support, the **latex** contains anthraquinones with laxative effects, and the **inner gel** is composed of water and polysaccharides with healing properties (Pareek, Nagaraj, Sharma, Naidu, & Yousuf, 2013).

The plant is native to North Africa and the Arabian Peninsula, but is now cultivated worldwide, especially in India, the Mediterranean, and the Americas (Hamman, 2008). Adaptations such as CAM photosynthesis allow survival in arid climates (Kumar, Yadav, Yadav, & Yadav, 2017).

3. Ethnomedicinal Uses

- **Ayurveda:** Aloe (*Kumari*) as a rejuvenator, laxative, uterine stimulant, and skin tonic (Ghazanfar, 1994).
- **TCM:** *Lu Hui* for constipation, fever, and skin diseases (Hamman, 2008).
- **Unani medicine:** *Sibr* for constipation, piles, and skin infections (Surjushe et al., 2008).
- **Arabian medicine:** Gel applied to treat fever, wounds, and headaches (Ghazanfar, 1994).
- **African traditions:** Used for burns, stomach cramps, and as a spiritual protective plant (Eshun & He, 2004).
- **Latin America:** Juice consumed for diabetes, hypertension, and gastrointestinal ailments (Hu et al., 2003).

The convergence of these practices underscores its ethnopharmacological importance.

4. Phytochemistry

Over 75 active compounds have been identified:

- **Polysaccharides:** Acemannan and glucomannan with wound-healing and immunomodulatory activity (Peng et al., 1991; Pareek et al., 2013).
- **Anthraquinones:** Aloin and emodin with laxative, antimicrobial, and antiviral properties (Shelton, 1991).
- **Sterols:** Lupeol, β-sitosterol, campesterol with anti-inflammatory and analgesic actions (Pareek et al., 2013).
- **Enzymes:** Bradykininase, reducing inflammation (Yagi, Harada, & Muroi, 1982).
- **Vitamins and minerals:** Antioxidant support from vitamins A, C, E, and minerals (Hamman, 2008).
- **Hormones:** Auxins and gibberellins aiding wound healing (Pareek et al., 2013).

5. Pharmacological Activities

- **Wound healing:** Acemannan stimulates macrophages and re-epithelialization (Peng et al., 1991).
- **Anti-inflammatory:** Bradykininase and salicylic acid reduce pain and inflammation (Yagi et al., 1982).
- **Antimicrobial:** Aloe gel inhibits *Streptococcus pyogenes* and *Candida albicans* (Pareek et al., 2013).

- **Immunomodulatory/anticancer:** Acemannan induces cytokine production and antitumor activity (Peng et al., 1991).
- **Laxative:** Anthraquinones stimulate bowel movement (Shelton, 1991).
- **Dentistry:** Acemannan hydrogel reduces alveolar osteitis post-extraction (Pareek et al., 2013).

6. Clinical Evidence

- **Oral lichen planus:** Aloe gel reduced lesions compared to placebo and steroids (Yavagal, Sivasamy, & Nagesh, 2012).
- **Burns:** Aloe cream accelerated superficial burn healing (Surjushe et al., 2008).
- **Psoriasis:** Mixed outcomes—some RCTs show benefits, others no significant difference (Eshun & He, 2004).
- **Diabetes:** Meta-analyses suggest improvement in fasting glucose, but results are inconsistent (Hu et al., 2003).
- **Safety:** Gel is safe; latex has GI irritation and possible carcinogenicity risks (Hamman, 2008).

7. Mechanistic Insights

Polysaccharides modulate immune function and wound repair (Peng et al., 1991), bradykininase reduces inflammation (Yagi et al., 1982), anthraquinones provide antimicrobial and laxative actions (Shelton, 1991), and sterols contribute anti-inflammatory effects (Pareek et al., 2013).

8. Challenges and Standardization

Phytochemical variability due to geography, cultivar, and processing hampers reproducibility (Kumar et al., 2017). Standardized extracts with defined acemannan content and limited anthraquinones are essential (Hamman, 2008).

9. Future Directions

- Standardize Aloe extracts with biochemical assays.
- Conduct large-scale RCTs in dermatology and dentistry.
- Explore microbiome-modulating effects.
- Investigate synergistic ethnomedicinal combinations.

10. Conclusion

Aloe vera bridges ethnopharmacological heritage with biomedical science. Its diverse phytochemistry underpins wound-healing, anti-inflammatory, and antimicrobial activities, validated by clinical studies in oral lichen planus, burns, and dentistry. However, extract standardization and robust clinical trials remain priorities. Integrating traditional knowledge with modern pharmacology may establish Aloe as a model ethnopharmacological drug.

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