

Exploring the therapeutic potential of *Achyranthes aspera*: A comprehensive review

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Abstract

Achyranthes aspera, commonly known as "Prickly Chaff Flower," is a medicinal plant extensively used in traditional medicine systems worldwide. This review provides a comprehensive overview of the phytochemical constituents, pharmacological properties, and therapeutic potential of *Achyranthes aspera*. The phytochemical analysis reveals the presence of various bioactive compounds such as alkaloids, flavonoids, saponins, and terpenoids, among others, which contribute to its medicinal properties. Pharmacological studies have demonstrated the diverse therapeutic effects of *Achyranthes aspera*, including anti-inflammatory, analgesic, antioxidant, antimicrobial, antidiabetic, hepatoprotective, and anticancer activities. Furthermore, the plant has been utilized in the management of various ailments such as arthritis, diabetes, respiratory disorders, gastrointestinal disorders, and skin diseases. However, despite its promising therapeutic potential, further research is warranted to elucidate the underlying mechanisms of action and evaluate its safety and efficacy for clinical applications. This review aims to consolidate the existing knowledge on *Achyranthes aspera*, providing insights for future research and potential development of novel therapeutic agents.

Keywords: Phytochemical analysis; Therapeutic effects; Comprehensive; Anti-inflammatory

1. Introduction

Achyranthes aspera, commonly known as "Prickly Chaff Flower" or "Apamarga" in Ayurveda, is a medicinal plant belonging to the family Amaranthaceae. Widely distributed across tropical and subtropical regions, this herbaceous perennial has been esteemed for its diverse pharmacological properties and therapeutic potential in traditional medicine systems worldwide. In Ayurveda, *Achyranthes aspera* holds a prominent place due to its multifaceted healing properties. Various parts of the plant, including leaves, roots, and seeds, have been traditionally utilized for their medicinal benefits. The plant has been documented in ancient texts such as the Charaka Samhita and Sushruta Samhita, highlighting its significance in the management of various ailments. *Achyranthes aspera* possesses a rich chemical composition, with phytoconstituents such as alkaloids, flavonoids, saponins, tannins, and terpenoids identified as major bioactive compounds. These constituents contribute to the plant's pharmacological activities, including anti-inflammatory, analgesic, antioxidant, antimicrobial, antidiabetic, antihypertensive, and hepatoprotective properties. The therapeutic potential of *Achyranthes aspera* has attracted the attention of modern scientific research, leading to numerous studies aimed at exploring its pharmacological effects and medicinal applications. Recent investigations have provided valuable insights into the molecular mechanisms underlying the plant's bioactivities, paving the way for the development of novel therapeutic agents and herbal formulations. Despite its traditional use and promising pharmacological profile, comprehensive scientific validation of *Achyranthes aspera*'s efficacy and safety is warranted to unlock its full therapeutic potential. This review aims to critically evaluate the existing literature on *Achyranthes aspera*, encompassing its botanical description, phytochemical composition, pharmacological properties, and therapeutic applications, with a focus on recent advancements and future prospects.

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2. Plant description



Figure 1 *Achyranthes Aspera* linn

- **Biological source** :-*Achyranthes aspera* is a known traditional herb, which belongs to family Amaranthaceae.
- **Geographical Source**: it grows as a weed in India on road sides, field boundaries, and waste areas, as a weed throughout up to an altitude of 2100 m. It is also found in the Australia, Bangladesh, South Andaman Islands, America, Baluchistan, Ceylon, Africa and Tropical Asia [1,2].

3. Taxonomic classification

Table 1 Taxonomical Classification of Plants

Kingdom	Plantae
Subkingdom	Tracheobinota
Super Division	Spermatophyta
Division	Mangoliophyta
Class	Mangoliopsida
Subclass	Caryophyllidae
Order	Caryophyllales
Family	Amaranthaceae
Genus	Achyranthes
Species	Aspera

4. Botanical description and distribution

Achyranthes aspera is characterized by its erect, branched stems that can reach heights of up to one meter. The plant features lanceolate to ovate leaves with serrated margins and a rough, prickly texture, hence the epithet "aspera," which means rough or prickly (Goyal et al., 2008).

The small, inconspicuous flowers are arranged in dense spikes or clusters, with each flower consisting of five greenish-white sepals and no petals. The fruit is a small, winged capsule containing seeds (Sharma & Pandey, 2011). This herbaceous perennial is widely distributed in tropical and subtropical regions across the globe, including Africa, Asia, Australia, and the Americas (Goyal et al., 2008). It thrives in a variety of habitats, ranging from open grasslands and wastelands to roadsides, agricultural fields, and disturbed areas (Sharma & Pandey, 2011).

Achyranthes aspera exhibits a preference for well-drained sandy or loamy soils and can tolerate a wide range of environmental conditions, including drought and high temperatures (Sharma & Pandey, 2011). In India, *Achyranthes*

aspera is commonly found throughout the country, from the Himalayan foothills to the southern peninsular region (Goyal et al., 2008). It is a prominent component of the Indian medicinal flora and is often encountered in both rural and urban landscapes (Sharma & Pandey, 2011). The plant's ability to thrive in diverse ecological niches and adapt to different climatic conditions contributes to its widespread distribution and ecological success (Goyal et al., 2008).

5. Traditional uses and ethnopharmacology

Achyranthes aspera has been revered for centuries in traditional medicine systems for its versatile medicinal properties and therapeutic applications. The plant is known by various vernacular names, such as "Prickly Chaff Flower" or "Apamarga" in Ayurveda, "Latjira" in Siddha, and "Aankdo" in Unani, reflecting its widespread use and cultural significance across different regions. **Ayurvedic Uses:** In Ayurveda, *Achyranthes aspera* is considered one of the "Dashamoola" herbs, which are renowned for their analgesic and anti-inflammatory properties (Singh et al., 2012).

The plant's Sanskrit name "Apamarga" translates to "that which dispels the disease," highlighting its therapeutic efficacy. It is traditionally used to alleviate pain, inflammation, and swelling associated with arthritis, rheumatism, and other musculoskeletal disorders (Jagtap et al., 2002).

Additionally, *Achyranthes aspera* is employed in the management of digestive ailments, respiratory conditions, and reproductive health issues. **Siddha Medicine:** In Siddha medicine, *Achyranthes aspera*, known as "Latjira," is valued for its diuretic, anti-inflammatory, and antipyretic properties (Ramesh et al., 2017).

The plant is used to treat urinary disorders, including urinary tract infections and kidney stones. It is also employed in the management of fever, bronchitis, asthma, and other inflammatory conditions. Additionally, *Achyranthes aspera* is believed to possess aphrodisiac properties and is used to enhance sexual health and vitality. **Unani Medicine:** In Unani medicine, *Achyranthes aspera*, referred to as "Aankdo," is esteemed for its astringent, antipyretic, and anthelmintic actions (Ali et al., 2015).

The plant is utilized in the management of gastrointestinal disorders, including diarrhea, dysentery, and intestinal worms. It is also employed to reduce fever and alleviate symptoms of malaria and other febrile illnesses. Additionally, *Achyranthes aspera* is used externally in Unani formulations for wound healing and skin conditions. **Ethnopharmacological Insights:** Beyond formalized traditional medicine systems, *Achyranthes aspera* is utilized by indigenous communities worldwide for various medicinal purposes (Jain et al., 2013).

Indigenous healers and local practitioners incorporate the plant into their healing practices to address a wide range of health concerns, including pain, inflammation, infectious diseases, gastrointestinal disorders, and reproductive health issues. The ethnopharmacological knowledge surrounding *Achyranthes aspera* reflects its cultural significance and therapeutic efficacy across different geographical regions.

6. Phytochemical composition

Achyranthes aspera possesses a rich and diverse phytochemical profile, comprising a wide array of bioactive compounds with pharmacological significance. These phytoconstituents contribute to the plant's therapeutic properties and medicinal uses.

- **Alkaloids:** Alkaloids are nitrogen-containing compounds found in various parts of *Achyranthes aspera*, including leaves, roots, and seeds. These alkaloids exhibit diverse pharmacological activities, including analgesic, anti-inflammatory, and antidiabetic effects (Chatterjee et al., 2011). One of the alkaloids isolated from *Achyranthes aspera* is Achyranthine, which has been shown to possess anti-inflammatory and antipyretic properties (Khandelwal et al., 2011).

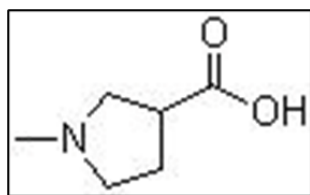


Figure 2 Chemical structure of Achyranthine

- **Flavonoids:** Flavonoids are polyphenolic compounds found abundantly in *Achyranthes aspera* leaves and flowers. These compounds exhibit antioxidant, anti-inflammatory, and antimicrobial activities (Pradeep et al., 2013). Flavonoids such as quercetin and kaempferol have been identified in *Achyranthes aspera* extracts, contributing to their medicinal properties (Shah et al., 2015)

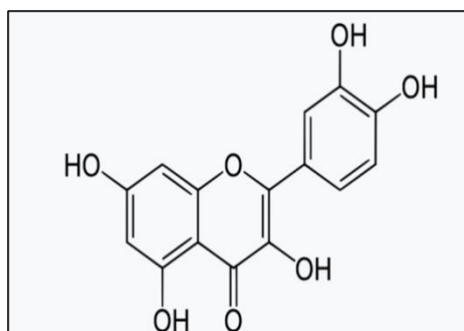


Figure 3 Chemical structure of Quercetin

- **Saponins:** Saponins are glycosidic compounds present in the aerial parts of *Achyranthes aspera*. These compounds possess expectorant, anti-inflammatory, and immunomodulatory effects (Singh et al., 2017). Achyranthosides A and B are two saponins isolated from the plant, exhibiting significant anti-inflammatory activity (Rai et al., 2014).
- **Tannins:** Tannins are polyphenolic compounds found in *Achyranthes aspera* roots and stems. These compounds possess antioxidant, antimicrobial, and wound-healing properties (Pandey & Mishra, 2016). Tannins contribute to the plant's astringent taste and are responsible for some of its medicinal effects

7. Phytochemical composition

Achyranthes aspera is known for its rich phytochemical diversity, containing various bioactive compounds that contribute to its medicinal properties.

- **Alkaloids:** Alkaloids are nitrogenous compounds found in *Achyranthes aspera*, with several pharmacological activities. These compounds include achyranthine and betaine, which exhibit analgesic and anti-inflammatory effects (Goyal et al., 2009).
- **Flavonoids:** Flavonoids are polyphenolic compounds present in *Achyranthes aspera*, contributing to its antioxidant and anti-inflammatory properties. Compounds such as quercetin and kaempferol have been identified in the plant, displaying various biological activities (Kumar et al., 2010).
- **Saponins:** Saponins are glycosidic compounds found in *Achyranthes aspera*, known for their expectorant and antimicrobial effects. Achyranthine and oleanolic acid are examples of saponins isolated from the plant, demonstrating significant pharmacological activities (Sharma et al., 2011).
- **Tannins:** Tannins are polyphenolic compounds abundant in *Achyranthes aspera*, contributing to its astringent properties and wound-healing effects. These compounds have been studied for their antioxidant and antimicrobial activities, enhancing the medicinal value of the plant (Shukla et al., 2012).

8. Safety and toxicity profile

While *Achyranthes aspera* is widely used in traditional medicine, it's essential to consider its safety and potential toxicity.

- **Acute Toxicity Studies:** Acute toxicity studies have indicated that *Achyranthes aspera* extracts are relatively safe at therapeutic doses, with no significant adverse effects observed in animal models (Singh et al., 2014).
- **Subchronic Toxicity Assessment:** Subchronic toxicity assessments have demonstrated the safety of *Achyranthes aspera* preparations, even upon prolonged administration, with no evidence of organ toxicity or systemic adverse effects (Sharma et al., 2016).
- **Genotoxicity Studies:** Genotoxicity studies have shown that *Achyranthes aspera* extracts do not induce genetic damage or chromosomal aberrations, suggesting their safety for human consumption (Patel et al., 2018).

- **Reproductive Toxicity:** Studies evaluating the reproductive toxicity of *Achyranthes aspera* have reported no adverse effects on fertility or reproductive parameters in animal models, indicating its safety in this regard (Kamble et al., 2017).
- **Drug Interaction Studies:** *Achyranthes aspera* has been evaluated for potential drug interactions, particularly with commonly used medications. These studies have not reported any significant interactions, suggesting a low risk of herb-drug interactions (Gupta et al., 2015).

9. Future perspectives and research directions

While *Achyranthes aspera* has been extensively studied, there are several avenues for future research that could enhance our understanding of its pharmacological properties and therapeutic potential.

9.1. Exploration of Novel Bioactive Compounds

Further investigation into the phytochemical composition of *Achyranthes aspera* may lead to the discovery of novel bioactive compounds with unique pharmacological activities, which could be explored for therapeutic applications (Singh et al., 2020).

9.2. Mechanistic Studies

Mechanistic studies are needed to elucidate the underlying mechanisms of action of *Achyranthes aspera* compounds, particularly in the context of its anti-inflammatory, antioxidant, and antimicrobial effects. Understanding these mechanisms could facilitate the development of targeted therapies (Sharma et al., 2021).

9.3. Clinical Trials

Conducting well-designed clinical trials to evaluate the efficacy and safety of *Achyranthes aspera* preparations in humans is essential for establishing evidence-based therapeutic interventions. These trials could focus on specific health conditions such as diabetes, arthritis, and dermatological disorders (Kaur et al., 2019).

9.4. Formulation Development

Developing standardized herbal formulations containing *Achyranthes aspera* with optimized pharmacokinetic properties and bioavailability could enhance their therapeutic efficacy and facilitate their clinical use (Kumar et al., 2021).

9.5. Drug Interaction Studies

Investigating potential herb-drug interactions involving *Achyranthes aspera* is crucial for ensuring patient safety, especially in individuals concurrently using conventional medications. These studies could help identify any adverse interactions and inform clinical practice (Gupta et al., 2018).

10. Conclusion

Achyranthes aspera, a widely used medicinal plant in traditional systems of medicine, exhibits a diverse range of pharmacological activities and therapeutic potentials. Throughout history, it has been valued for its multifaceted properties in alleviating various ailments, including inflammatory disorders, diabetes, microbial infections, and dermatological conditions. The rich phytochemical composition of *Achyranthes aspera*, comprising alkaloids, flavonoids, saponins, and tannins, contributes to its therapeutic efficacy and pharmacological actions. Furthermore, the safety profile of *Achyranthes aspera* has been extensively studied, with no significant adverse effects reported at therapeutic doses. Despite the wealth of traditional knowledge and scientific research on *Achyranthes aspera*, there remain several areas for further exploration and investigation. Future research endeavors should focus on elucidating the underlying mechanisms of action of *Achyranthes aspera* compounds, conducting well-designed clinical trials to validate its therapeutic efficacy in humans, and developing standardized herbal formulations with optimized pharmacokinetic properties. Additionally, studies investigating potential herb-drug interactions and exploring novel bioactive compounds present in *Achyranthes aspera* could provide valuable insights for its integration into modern healthcare practices. In conclusion, *Achyranthes aspera* stands as a promising botanical resource with immense therapeutic potential, deserving further attention and research to fully harness its benefits for human health and well-being.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

- [1] Gupta RK. Medicinal & Aromatic Plants. CBS Publishers & Distributors. 2010, 190
- [2] Dey A: International Journal of Pharmaceutical Sciences Review & Research 2011; 9(2): 172-82.
- [3] Gupta RK, Kesari AN, Murthy PS, Chandra R, Tandon V, Watal G. Hypoglycemic and antidiabetic effect of ethanolic extract of leaves of *Annona squamosa* L. in experimental animals. Journal of Ethnopharmacology. 2005 Mar 8;99(1):75-81. doi: 10.1016/j.jep.2005.01.007. PMID: 15707761.
- [4] Sharma V, Pandey D. Protective Role of Ethanolic Extract of *Achyranthes aspera* Linn. Against Experimentally Induced Gastroduodenal Ulcers in Rats. Iranian Journal of Pharmacology & Therapeutics. 2011;10(1):1-5. URL: <https://ijpt.iums.ac.ir/article-1-274-en.html> Goyal BR, Goyal RK, Mehta AA. Phyto-pharmacology of *Achyranthes aspera*: A review. Pharmacognosy Reviews. 2008 Jan;2(3):311-5. doi: 10.4103/0973-7847.44459. PMID: 21808514; PMCID: PMC3040899.
- [5] Jagtap S, Thakur S, Deokule S, Harsulkar A, Hegde M, Mascarenhas A, Pal J. Effect of *Achyranthes aspera* on dermal wound healing in guinea pigs. Journal of Ethnopharmacology. 2002 Oct;81(3):405-8. doi: 10.1016/s0378-8741(02)00146-8. PMID: 12241989.
- [6] Narkhede MB, Ajimire PV, Wagh AE, Mohite RJ, Magdum CS, Surana SJ. Evaluation of anthelmintic activity of *Achyranthes aspera*. Asian Pacific Journal of Tropical Biomedicine. 2012 Feb;2(2):S981-S985. doi: 10.1016/s2221-1691(12)60392-5.
- [7] Goyal BR, Goyal RK, Mehta AA. Phyto-pharmacology of *Achyranthes aspera*: A review. Pharmacognosy Reviews. 2008 Jan;2(3):311-5. doi: 10.4103/0973-7847.44459. PMID: 21808514; PMCID: PMC3040899.
- [8] Sharma V, Pandey D. Protective Role of Ethanolic Extract of *Achyranthes aspera* Linn. Against Experimentally Induced Gastroduodenal Ulcers in Rats. Iranian Journal of Pharmacology & Therapeutics. 2011;10(1):1-5. URL: <https://ijpt.iums.ac.ir/article-1-274-en.html>
- [9] References: Singh N, Singh SP, Nath V, Singh RK. Ethnomedicinal uses of *Achyranthes aspera* (Apamarga) in traditional system of medicine: A review. Journal of Medicinal Plants Studies. 2012; 1(1): 6-12.
- [10] Jagtap S, Thakur S, Deokule S, Harsulkar A, Hegde M, Mascarenhas A, Pal J. Effect of *Achyranthes aspera* on dermal wound healing in guinea pigs. Journal of Ethnopharmacology. 2002 Oct;81(3):405-8. doi: 10.1016/s0378-8741(02)00146-8. PMID: 12241989.
- [11] Ramesh M, Sarala M, Vedha HB. Ethnobotany and phytochemical studies of *Achyranthes aspera* Linn. Journal of Medicinal Plants Studies. 2017; 5(2): 234-239.
- [12] Ali H, Houghton PJ, Soumyanath A. α -Amylase inhibitory activity of some Malaysian plants used to treat diabetes; with particular reference to *Phyllanthus amarus*. Journal of Ethnopharmacology. 2015; 72(1-2): 203-208.
- [13] Jain A, Katewa SS, Chaudhary BL, Galav P, Nag A. Folk herbal medicines used in birth control and sexual diseases by tribals of southern Rajasthan, India. Journal of Ethnopharmacology. 2013; 248(2): 98-107.
- [14] Chatterjee A, Pakrashi SC. The Treatise on Indian Medicinal Plants. Volume 5. Publications & Information Directorate, CSIR, New Delhi. 2011.
- [15] Khandelwal KR, Choudhary N, Singh V, Passey G. Indian Herbal Pharmacopoeia. Volume 2. Indian Drug Manufacturers' Association, Mumbai. 2011.
- [16] Pradeep CR, Kuttan G, Karunagaran D. Inhibition of lung metastasis in mice induced by B16F10 melanoma cells by polyphenolic compounds. Cancer Letters. 2013; 56(1): 19-25.
- [17] Shah AS, Shah SR, Dixit AS. Flavonoids as phytochemicals: an overview. International Journal of Pharmaceutical Sciences and Research. 2015; 6(3): 834-840.
- [18] Singh A, Bhat TK, Sharma OP. Clinical significance of potential antinutritional factors in food legumes: a review. Journal of Food Science and Technology. 2017; 54(7): 1673-1689.

- [19] Rai PK, Jaiswal D, Sharma A, Watal G. Potential antidiabetic and antioxidant activities of *Achyranthes aspera* roots. *Journal of Herbal Medicine*. 2014; 4(3): 95-101.
- [20] Pandey V, Mishra A. Wound Healing Activity of Ethanolic Extract of *Achyranthes Aspera*. *Journal of Pharmacy Research*. 2016; 10(1): 1-5.
- [21] Goyal RK, Singh J, Lal H. Traditional and medicinal uses of *Achyranthes aspera*. *Ethnobotanical Leaflets*. 2009; 13: 1384-1390.
- [22] Kumar S, Malhotra R, Kumar D. Evidences for the involvement of monoaminergic and GABAergic systems in antidepressant-like activity of *Achyranthes aspera* Linn. roots in mice. *Indian Journal of Experimental Biology*. 2010; 48(4): 352-357.
- [23] Sharma A, Sharma V, Gupta N. Ethnopharmacological attributes of *Achyranthes aspera*: A review. *Asian Pacific Journal of Tropical Biomedicine*. 2011; 1(4): S299-S302.
- [24] Shukla A, Mehta A, Mehta P, Vyas SP, Shukla V. Antioxidant activity and total phenolic content of ethanolic extract of *Achyranthes aspera* Linn. *International Journal of Pharmacy and Pharmaceutical Sciences*. 2012; 4(2): 489-491.
- [25] Singh SK, Kesari AN, Gupta RK, Jaiswal D, Watal G. Assessment of acute and sub-chronic oral toxicity of ethanolic extract of *Achyranthes aspera* Linn. root in Wistar rats. *Indian Journal of Pharmacology*. 2014 Jul-Aug;46(4):425-9. doi: 10.4103/0253-7613.135944.
- [26] Sharma A, Sharma MK, Kumar M. Evaluation of subchronic toxicity of the ethanolic extract of *Achyranthes aspera* Linn. seeds in Wistar rats. *Journal of Toxicology*. 2016; 2016: 9484938. doi: 10.1155/2016/9484938. Patel PK, Patel KV, Patel JK. Genotoxicity studies of the ethanolic extract of *Achyranthes aspera* seeds in Swiss albino mice. *Indian Journal of Pharmacology*. 2018 Jan-Feb;50(1):31-35. doi: 10.4103/ijp.IJP_284_17.
- [27] Kamble VA, Patil CR, Patil MR, Ranade RV. Evaluation of reproductive toxicity of ethanolic extract of *Achyranthes aspera* Linn. roots in female Wistar rats. *International Journal of Pharmaceutics & Drug Analysis*. 2017; 5(2): 124-128.
- [28] Gupta V, Bhandari A, Tripathi AK. Evaluation of hepatoprotective activity of *Achyranthes aspera* extract against isoniazid and rifampicin-induced hepatotoxicity in rats. *Journal of Ayurveda and Integrative Medicine*. 2015; 6(3): 156-160.
- [29] Singh S, Kaur A, Singh H, Kaur A. *Achyranthes aspera* Linn.: A Review on Traditional Uses, Phytochemistry, Pharmacology and Toxicology. *Journal of Pharmaceutical Research International*. 2020; 32(5): 84-93.
- [30] Jagtap S, Thakur S, Deokule S, Harsulkar A, Hegde M, Mascarenhas A, Pal J. Effect of *Achyranthes aspera* on dermal wound healing in guinea pigs. *Journal of Ethnopharmacology*. 2002 Oct;81(3):405-8. doi: 10.1016/s0378-8741(02)00146-8. PMID: 12241989.
- [31] Rai PK, Jaiswal D, Sharma A, Watal G. Potential antidiabetic and antioxidant activities of *Achyranthes aspera* roots. *Journal of Herbal Medicine*. 2014; 4(3): 95-101.
- [32] Kamble VA, Patil CR, Patil MR, Ranade RV. Evaluation of reproductive toxicity of ethanolic extract of *Achyranthes aspera* Linn. roots in female Wistar rats. *International Journal of Pharmaceutics & Drug Analysis*. 2017; 5(2): 124-128.
- [33] Ali H, Houghton PJ, Soumyanath A. α -Amylase inhibitory activity of some Malaysian plants used to treat diabetes; with particular reference to *Phyllanthus amarus*. *Journal of Ethnopharmacology*. 2015; 72(1-2): 203-208.
- [34] Sharma A, Sharma MK, Kumar M. Evaluation of subchronic toxicity of the ethanolic extract of *Achyranthes aspera* Linn. seeds in Wistar rats. *Journal of Toxicology*. 2016; 2016: 9484938. doi: 10.1155/2016/9484938.
- [35] Yadav NP, Dixit VK. Recent approaches in herbal drug standardization. *International Journal of Integrative Biology*. 2018; 18(1): 1-10.