

# Lesotho Medicinal Plants of the Asteraceae Family: A Review of the Ethnobotany, Chemistry and Conservation Status

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**Abstract:** Plants have and continue to play a pivotal role in the wellbeing of humankind, either in the form of food, fuel, medicine or shelter. Several plant species from a diverse range of families are used in Lesotho for medicinal purposes. For example, *Dicoma anomala* (hloenya) is used to treat breast cancer while *Aster bakerianus* (phoa) is effective against sexually transmitted infections (STIs), particularly syphilis. While ethnobotanical information about most of Lesotho medicinal plants is well documented, the scientific validation and conservation status of these plants remain subjects of concern. In spite of their important role in primary healthcare and as sources of livelihood, medicinal plants in Lesotho are faced with ever-increasing threats. Exponential growth in trade of some of these plants, coupled with socio-economic factors lead to unsustainable and uncontrolled harvesting [2, 3]. Climate change, overgrazing and veld fires also add to the problem. The family, Asteraceae provides an arguably significant number of Lesotho plant species used in traditional herbal medicine. This study provides an in depth account of the ethnobotany, chemistry and conservation status of selected medicinal plant species of the family, Asteraceae that are commonly used in Lesotho traditional medicine and cited most in the literature. According to the literature, the ethnobotanical information for the sampled species is satisfactorily preserved. The reported medicinal uses cover a wide range of ailments from circulatory, gastrointestinal, respiratory, reproductive, pain relief, digestive and other non-classified sicknesses. Terpenoids (especially sesquiterpene lactones), flavonoids and phloroglucinols are some of the characteristic metabolites of this family. The observed biological activities are in close agreement with the reported metabolites. This study concludes that the ethnobotanical knowledge of Lesotho medicinal plants of the family, Asteraceae is adequately covered. However, gaps still exist in the isolation of active ingredients (drugs) for pharmaceutical purposes and elucidation of their mechanisms of action. The issue of conservation of Lesotho flora remains a challenge even today.

**Keywords:** Review, Lesotho medicinal plants, Asteraceae, Conservation status.

## 1. Introduction

The flora of Lesotho comprises about 3,000 species, belonging to 800 genera and 200 families [4]. Economically, it provides food, energy, shelter, handicrafts, clean environment and medicine to Basotho. It is noteworthy that rural population of Lesotho depends heavily on biological resources, especially plants, for their livelihoods [5]. The rate of harvesting this natural resource, without replenishing, however, is exceedingly high. This puts too much pressure on this already dwindling resource. The problem is exacerbated by factors such as climate change, wild fires, unsustainable use and destruction of habitats. Asteraceae (Compositae) is one of the best represented families in the flora of Lesotho. Commonly known as the sunflower family, daisies (members of the Asteraceae family) exist as herbs, some as shrubs,

and rarely trees. Globally, it is the largest family of dicotyledons, comprising about 2000 genera, and 32, 913 species [6]. The family has a cosmopolitan distribution although it is most abundant in tropical and subtropical regions, as well as the lower temperate latitudes [7]. Daisies can be distinguished from other plants by their characteristic inflorescent flowers [8]. They are best known as producers of sesquiterpene lactones of various forms. The absence of irridoids in their essential oils gives them a unique property compared to essential oils from other plants [9]. Members of this family find use in food, cola, insecticide and cigarette industry (*Tagetes* spp), as well traditional medicine (*Artemisia*). *Helianthus annuus* (domestic sunflower), is best known as the source of cooking oil. Several genera are of horticultural importance (*Chrysanthemum*, *Calendula*) [10].

Research suggests that the family Asteraceae, provides a significant number of Lesotho plant species used in traditional medicine. Moteete has conducted several ethonobotanical researches on the flora of Lesotho. Most of her research work was premised on the literature from Phillips, Watt & Breyer-Brandwijk, Hutchings and Guillamord. Further studies, on different aspects, have been done by Maliehe, Letsela, Shale, Mugomeri, Seleteng-Kose, Motjotji, Van Wyk, Asita etc. While ethonobotanical information about several members of this family is well documented, as chemical studies, including scientific validation of the myriad ethnomedicinal uses are underestimated. The conservation status of not only members of this family, but the flora of Lesotho as a whole remains unaddressed. Furthermore, reviews that compare and contrast among members of this family are unknown. This review, therefore, provides an in depth account of the ethnobotany, chemistry and conservation status of selected members of the Asteraceae family that dominate Lesotho traditional herbal remedies and are cited most in the literature.

## 2. Materials and Methods

A comprehensive literature search from online databases (google, google scholar etc), in published and unpublished articles (journal articles, dissertations, theses etc.) and books provided the main sources of information used in this paper.

## 3. Results and Discussion

### *Traditional and medicinal uses of the family:*

One of the greatest applications of members of the Asteraceae family in Lesotho is in traditional medicine. Few other applications include sources of energy (firewood) for cooking purposes (*Aster*, *Athanasia*, *Eriocephalus*, *Chrysocoma* spp), and as wild vegetables (*Gerbera*, *Hypochaeris*, *Senecio* and *Sonchus* spp) [5]. Nearly all the plants in this review are used to treat coughs, fevers and colds; influenza and gastrointestinal disorders. Diabetes, one of the non-communicable diseases in Lesotho is best treated using decoction from the likes of *Artemisia afra* and *Dicoma anomala*. Other ailments treated are related to skin problems, reproductive, circulatory, cardiovascular, degenerative, CNS-related disorders and general aches. Detailed account is given in Appendix 1.

### *Phytochemistry:*

Medicinal applications of plants are largely determined by the presence of active ingredients (active compounds) present in those plants. These compounds may exert medicinal properties on their own i.e in

isolation. Sometimes a group of compounds may work together (synergy) to exert certain attributes of medicinal value. A wide range of metabolites have been reported from Asteraceae. The commonest include terpenoids, flavonoids and their derivatives, and iso/phloroglucinols. Sesquiterpene lactones are the largest class of terpenoids that characterize Asteraceae. They are largely responsible for the observed biological activities of most members of this family. It has been argued that flavonoids play a vital in the prevention of neurological and cardiovascular diseases [11-12]. Other metabolites of medicinal value include saponins, phenyl propanoids, alkaloids, fumaric and caffeic acids. The unique characteristic of most members of this family is the absence of irridoids in the essential oils isolated. The genera *Helichrysum*, *Artemisia* and *Eriocephalus* are reputed for their rich essential oils.

### *Examples of typical biological activities:*

**Antioxidant activity:** Among the top ten causes of death in Lesotho are degenerative diseases such as heart failure, anaemia, *diabetes mellitus* and stroke, which are generally linked to oxidative stress. The therapeutic benefit of medicinal plants in the treatment of degenerative diseases is attributed to their antioxidant properties [13]. Bioactive phenols (especially bioflavonoids) are very interesting as antioxidants because of their natural origin and the ability to act as efficient free radical scavengers [11-12]. Extracts from plants such as *A. afra*, *B. setifera*, *E. panctulatus* and *H. odoratissimum* have been studied and found to possess antioxidant properties on DPPH and ABTS cations. This activity is attributed to the flavonoids and other polyphenolic compounds that have been isolated from them. The volatile oil of *Artemisia afra* has shown antioxidant and antimicrobial activities [14]. Evaluation of the antioxidant and free radical scavenging properties of *Berkheya setifera* showed that the plant scavenged DPPH radicals and hydrogen peroxide. The plant further reduced  $Fe^{3+}$  to  $Fe^{2+}$  and was found to contain phenolics. A fair degree of correlation between the amount of total phenolic substances and the activity was established, where extracts with high content of phenolics gave higher activity [13].

**Anti-inflammatory activity:** All, but three, of the selected members of the Asteraceae have been studied and showed anti-inflammatory activity. These include *S. pinnata*, *H. scarposa*, *S. asperulus*, *B. setifera*, *D. anomala* and *Helichrysum* species. It has been reported that sesquiterpene lactones exhibit anti-inflammatory and immunomodulatory actions, properties that can be beneficial in tumor treatment [15]. The anti-inflammatory activity of most members of the

Asteraceae can therefore be attributed to the presence of sesquiterpene lactones.

Antimicrobial (antibacterial, antifungal, anti-mycobacterial, antiviral) activity: Extracts from *A. afra*, *B. setifera*, *G. woodii*, *E. punctulatus*, *S. pinnata*, *O. natalensis*, *Senecio* and *Helichrysum* species all show antimicrobial properties of varying degrees. *Senecio asperulus* has traditionally been used in the treatment of herpes and syphilis. A wide application of most members of this family in the treatment of sores and wounds is testimony to their antimicrobial activities. The antimicrobial activity of the volatile oil of *Artemisia afra* has been highlighted in the previous sections. Antiseptic leaf decoctions of *Schkuhria pinnata* are used in the treatment of wounds and fevers. Antidiabetic activity: Diabetes mellitus has been declared the commonest endocrine disorder. Globally, an estimated 422 million adults were living with diabetes in 2014, compared to 108 million in 1980. Diabetes caused 1.5 million deaths in 2012 [16]. The root causes of diabetes mellitus are largely related to diet and people's lifestyles. In this changing world that is greatly influenced by western lifestyles, diabetes cases are alarmingly increasing. Consequently, plants play a central role in the search for effective remedial measures. Extracts of most plants under review have shown antidiabetic properties. This property has led to the extensive use of *D. anomala*, *A. afra*, *E. punctulatus*, *H. scaposa* and *S. pinnata* extracts by diabetic patients in Lesotho. *Artemisia afra* has been used to keep urine free from sugar in the case of diabetes mellitus [17]. Furthermore tea infusions of *S. pinnata* are used by traditional healers and herbalists in the Ga-Rankuwa area, Gauteng, to treat diabetes [18].

Antitumor activity: Research has proven that flavonoids and some sesquiterpene lactones can synergistically act against malaria and cancer [19]. In vitro anticancer screening of selected South African medicinal plants revealed that eucannabinolide, a sesquiterpene lactones isolated from the stems of *Schkuhria pinnata*, displayed the highest activity against the melanoma UACC62 cell line (TGI < 6.25 g/ml). Dichloromethane: methanol extract of *Artemisia afra* showed moderate activity against melanoma (SK-MEL-3M) and colon (HT29) strains [20]. Other metabolites that have shown antitumor properties include polyphenols and brassinosteroids.

Other miscellaneous activities: *Senecio asperulus* used in the treatment of mouth ulcers. The antimalarial activity of extracts of *S. pinnata* has promoted this plant as one of the most important herbs in the treatment of malaria in central Kenya. The powdered leaf of *S. pinnata* is swallowed with water as a remedy for ailments such as malaria, influenza and colds [17]. Other bioactivities from the literature are summarized in Appendix 2.

#### Conservation Status:

Surveys that are meant to establish the conservation status of Lesotho medicinal plants are scarce. Moreover, they are limited in scope and coverage. It turns out that South Africa is currently the only African country which has comprehensive data on conservation status of its flora. The current and only available information about the conservation of some Lesotho plants is in Lesotho Plant List 2002. The survey was limited to few plant families and species. Among the plant species in this review, *Dicoma anomala* is the only one that has a VU A2d status [4]. The authors are also informed that other subsidiary surveys were carried out for example, as part of Environment Impact Assessment (EIA) prior to the commencement of the Lesotho Highland Water Project. Only few plant species around the project area were evaluated. We have thus found it difficult to report the conservation status of the plants under study due to lack of adequate information.

The authors note that several initiatives by the government to protect the environment and biodiversity at large are in place. The government Policies, Bills, international Protocols and Acts have been ratified, and should be implemented without failure. The establishment of Katse Botanical garden, Sehlabathebe and Tsehlanyane National parks, Bokong Nature Reserve and the Liphofung Caves Cultural & Historical sites by the government is commendable. Again, institutional botanical gardens at the National University of Lesotho and Agricultural Research Unit of Lesotho Agricultural College are the right steps in the right direction

#### 4. Conclusions

According to this review, the ethnobotanical information for the sampled species is satisfactorily preserved. Reported medicinal uses cover a wide range of ailments that include circulatory, gastrointestinal, respiratory, reproductive, pain relief, digestive and other non-classified sicknesses. Terpenoids (particularly sesquiterpene lactones) and several flavonoids derivatives are the main metabolites of this family. The observed biological activities are in agreement with the reported metabolites. Gaps do exist, however, in the isolation of active ingredients (compounds) and elucidation of their mechanisms of action. Undoubtedly, it is revealed that Asteraceae are very important in Lesotho traditional remedies. Cooperation in conservation strategies and policies is required at all levels, while ensuring that management initiatives take into account local market conditions and the socio-economic realities facing both consumers and those who depend on the trade for their livelihoods.

## 5. Conflicts of interest

The authors have no conflicts of interest.

## 6. Acknowledgements

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