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Review article

Traditionally used ethnomedicinal plants for the treatment of cancer and diabetes in Nepal

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Abstract

Traditional medicines play an important role in healthcare provision. The traditional system of medicine based on medicinal plants in Nepal presents a strong relationship among natural remedies, health, diet, and folk healing practices. In recent years, evidence supports the effectiveness of herbal medicines in controlling blood sugar levels, functioning as anti-tumorous agents, and holistically boosting the immune system. Limited baseline research and current knowledge gaps, however, make it difficult to establish evidence for traditional knowledge of plant-based medicines that treat cancer and diabetes. This study aimed to identify and document the medicinal plants used by traditional medicine practitioners in Nepal to treat cancer and diabetes and to explore the intricate socio-cultural relationship. More than 70 published papers were retrieved from the online bibliographical database. The scientific name, common name, family, parts used, and their role in the treatment of diabetes and cancer were enumerated. The present review reported that 125 species belonging to 72 families have been used in Nepal. This review contributes to the knowledge of certain medicinal plants that are prevalent for the prevention and treatment of cancer (tumor) and diabetes, and which can be further investigated to produce new drugs with fewer side effects and better patient compliance.

Keywords: Ethnomedicine, traditional healthcare, traditional medicine.

Introduction

Natural products have played a crucial role in human healthcare since the origin of humankind and continue to remain indispensable even in the modern era of advanced therapeutics. Since the beginning of human civilization, plants have been utilized for medicinal purposes, particularly in the Hindu-Kush Himalayan region. Evidence of this practice is well documented in ancient Ayurvedic texts, such as the Rigveda (4500–1600 BC), which is considered the oldest repository of knowledge on the medicinal uses of plants and other natural products in the region.

Even today, the most widely used and recognized forms of medicines throughout the world are plant-derived products. The use of plant resources as medicine is a part of traditional heritage and is deeply embedded in the cultural practices of the indigenous people of both developed (Tomlinson and Akerele 2015) and developing countries (Chaudhary 1998; Rokaya *et al.* 2010; Luitel *et al.* 2014). Indigenous communities possess rich knowledge and long-standing experience in utilizing plant species for healthcare (Rai and Pokhrel 2006). A large proportion of the population in many developing countries still relies on traditional practitioners and medicinal plants to meet primary healthcare needs. Medicinal plants are increasingly gaining popularity because of several perceived advantages, such as fewer side effects, cost-effectiveness for low-income populations, and better patient compliance (Brown *et al.* 2008). However, in Nepal, the effectiveness of traditional medicine-based treatments is often questioned due to limited scientific validation. Recognizing this gap, the present review attempts to provide baseline scientific evidence and deeper insights into the efficacy of traditionally used medicinal plants.

As a primary goal, this study aimed to identify plant species used by traditional medicine practitioners (TMPs) in Nepal for the treatment of cancer and diabetes and to explore the underlying human-plant relationships. Relevant literature was retrieved from online databases, such as PubMed, Google Scholar, and ScienceDirect. More than 70 relevant publications on ethnomedicinal practices across different regions of Nepal were reviewed, which provided information on the use of different medicinal plant species for the management of various diseases, especially diabetes and cancer. The articles screened for this review included only traditionally used plants with ethnopharmacological evidence. Article having duplicate information and no full-text access were not included in the final analysis.

Traditional medicine

Traditional medicine refers to ways of protecting and restoring health that existed before the advent of modern medicine. The World Health Organization (WHO) defines traditional medicine as native health practices, approaches, knowledge, and beliefs that can be used alone or in combination to treat, diagnose, and maintain well-being (WHO 2004). Due to wider consumer inclination towards natural products, holistic healing, and ease of access, traditional herbal products are gaining popularity, and in recent days, their commercial value is considered to be increasing (Giri *et al.* 2023). According to the WHO, a third of the world's population has no regular access to essential modern medicines. In parts of Africa, Asia, and Latin America, it is estimated that about half of the population faces shortages of minimum healthcare facilities due to inadequate government financing. This poses glaring inequities in healthcare delivery in developing countries.

A heavy burden of communicable diseases (HIV/AIDS, malaria, TB, pneumonia, diarrhea), coupled with the advent of the growing threat of non-communicable diseases (NCDs) such as diabetes, cancer, hypertension, ischemic heart diseases, amongst many others, torment lives in developing countries. Plants contain a large number of pharmacologically active compounds, which can be directly used as healing agents or their phytochemicals serve as effective compounds for developing potential drugs for various ailments (Malla *et al.* 2015). It is a well-known fact that the majority of modern medicines have been formulated from herbal plants through an ethnobotanical background (Cox and Balick 1994). Medicinal plants attributed to traditional practices contribute to the fundamental healthcare of people in rural areas of the world. The different traditional systems of medicine practiced in various regions of the world are gaining wide currency and acceptability.

The trade of traditional medicinal plants is also a source of income for millions of people worldwide (Ghimire *et al.* 2016; Poudeyal *et al.* 2021). Due to its easy access, low cost and minimum adverse or side effects, developing countries, like Bangladesh (90%), Myanmar (80%), India (80%), Nepal (75%), Pakistan (75%), Sri Lanka (65%) and Indonesia (60%), rely on the traditional system of medicine for various ailments and health-related issues. The demand for ethnomedicinal plants is growing rapidly. The annual trade of such plants has reached approximately US $14 billion and is growing at a rate of 15 to 25%. About 80% people living in rural settings in developing countries use traditional medicine for their primary health care needs. Generally, cancer and diabetes patients are using traditional medicine as primary therapy and/or as complementary medicines to increase the body's resistance, boost, and rebalance the immune system.

Nepal is well known for its geographical and cultural diversity, rich in traditional and indigenous knowledge, recipes, and resources. There are about 8.4 million indigenous people of different groups inhabiting various terrains. They possess their own culture, religious rites, and rich traditional medicine practices. The traditional knowledge and its practices have been discriminated against from one generation to another through word of mouth, and hence need to be documented immediately. A limited number of studies have been carried out to document the ethnomedicinal use for the treatment of cancer and diabetes in Nepal. Human behavior has a direct impact on the plant communities with which they interact and these interactions are the objectives and targets of ethnobotany and ethnomedicine. The present review was envisaged to give insight into the ethnomedicinal plant diversity and their parts used for the treatment of cancer and diabetes.

Ethnomedicinal plants in Nepal

Nepal holds a rich diversity of medicinal plants because of its varied climatic, geological, geographical, physiographical, and topographical conditions. In Nepal, about 6653 species of Angiosperms have been documented, among which 1792 to 2331 species were recorded as potential medicinal and aromatic plants (Rokaya *et al.* 2010). Traditional herbal medicine in Nepal has a deep cultural and religious foundation. About 90% of the Nepalese people reside in rural areas where access to government health care facilities is lacking (Bhattarai *et al.* 2007). Thus, those ethnic people residing in different geographical belts of Nepal depend on wild plants to meet their basic requirements. In most cases, the ethnic communities have their own pool of secret ethnomedicinal and ethnopharmacological knowledge about the plants available in their surroundings, which has been serving rural people with its superiority.

Indigenous and local communities have been using traditional and indigenous knowledge for centuries under local regulations, ad hoc rules, customs, and traditions to cure different diseases. Thus, the collection of those resources based on indigenous practices not only supplies but also provides the system of management (Koirala and Khaniya 2009; Poudeyal *et al.* 2019). About 215 plant species are used to treat 139 types of diseases by major ethnic peoples in the hilly region of Nepal (Miya *et al.* 2020). Studies on ethnomedicinal plants in Nepal have been conducted in the past by the Nepalese and foreign researchers, and comprehensive works have already been published (Rajbhandari 2001; Manandhar 2002). Plants having medicinal properties have been studied from time to time in different parts of Nepal by several researchers (Manandhar 1993, 1995, 1998; Bhattarai 1998; Eigner and Scholz 1999; Joshi and Joshi 2000; Shrestha *et al.* 2001; Shrestha and Dhillion 2003; Mahato and Chaudhary 2003; Kunwar and Bussmann 2008; Panthi and Chaudhary 2003; Sharma *et al.* 2004; Bhattarai *et al.* 2006, 2009; Ghimire and Basakoti 2009; Kunwar *et al.* 2009; Acharya and Acharya 2009; Upreti *et al.* 2010; Joshi *et al.* 2011; Malla and Chhetri 2012; Thapa 2012; Malla *et al.* 2014; Gahatraj *et al.* 2020; Lamichhane *et al.* 2021). However, it is uncommon to find evidence of traditional knowledge of plant-based medicine that aids in the treatment of diabetes and cancer.

Anti-cancer and anti-diabetic plants

We reviewed 125 species of medicinal plants from 72 families, used by people from diverse cultural backgrounds and geographical areas in Nepal to treat cancer (17% of the species), diabetes (76%), and both cancer and diabetes (7%) (Table 1).

Fabaceae (38%), Asteraceae (19%), and Lamiaceae (19%) are the top families that accounted for the majority of the identified plants for the diabetes treatment (Figure 1). Similarly, Ranunculaceae (28%), Fabaceae (18%), and Liliaceae (18%) cover the majority of species among the plants used for the treatment of cancer. While considering for the plant parts-based utilities, fruits and seeds (31%), leaves (31%), and bark (17%) are the major components followed by other parts for the treatment of diabetes; and leaves (43%), flower (20%), whole plant parts (20%), and fruits and seeds (17%) followed by other parts for the cancer therapy (Figure 2). Further detailed information about the medicinal herbs that are beneficial in treating those diseases is provided in Table 1.

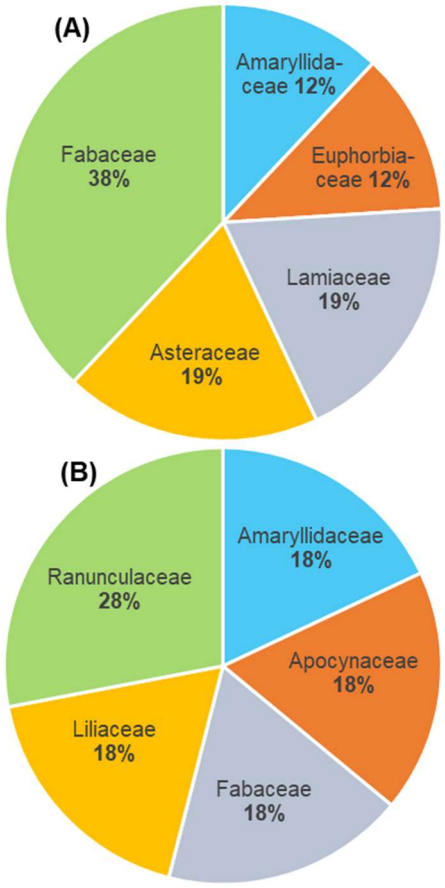

Figure 1. Family-wise distribution of traditionally used medicinal plant species for the treatment of diabetes (A) and cancer (B). Only the top five families are compared.

Cancer is the second leading cause of morbidity and mortality in the world. The number of cancer deaths has been projected to increase from 7 million in 2002 to 11.5 million in 2030. Cancer is one of the major burdens for public health, both in developed and developing countries. In 2012, there were 10.9 million new cases, 6.7 million deaths, and 24.6 million persons living with cancer around the world (Rashed 2014). Common anti-cancer medicines frequently cause induction of a chemotherapy-induced peripheral neuropathy (CIPN) in which both large and small primary afferent sensory neurons are injured, while others are known to suppress the bone marrow, making the patients prone to infections and other diseases.

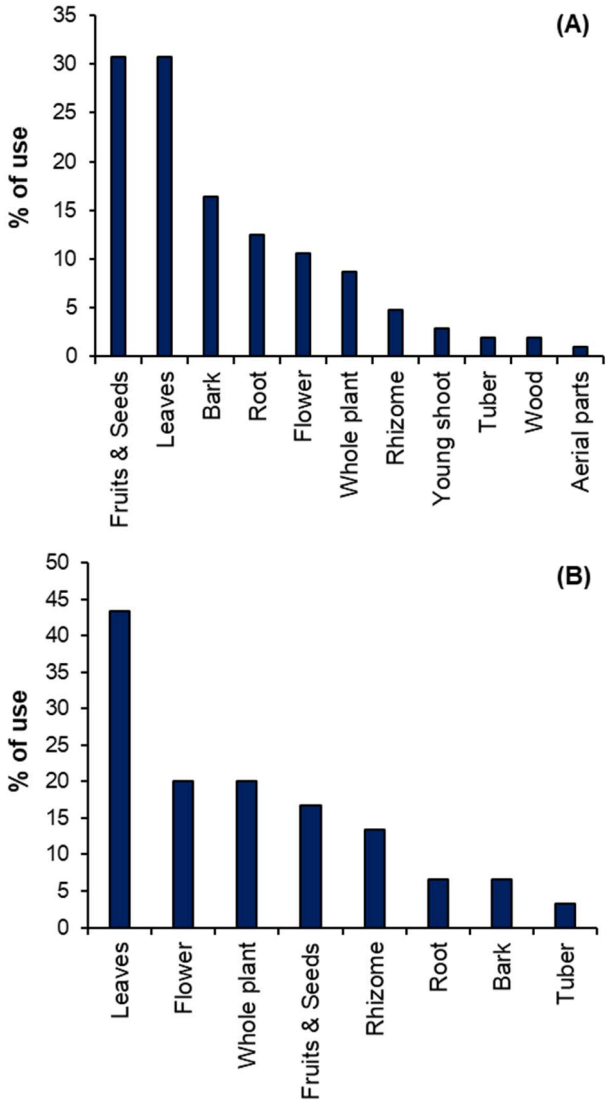

Figure 2. Parts used percentage in various plants for the treatment of diabetes (A) and cancer (B) in Nepal.

Thus, the development of medicines that offer optimal therapy for a condition and do not harm patients' quality of life is of optimal requirement. Several plant species possess a reservoir of bioactive compounds, but a very negligible percentage of which have been examined and continue to be a requisite source of anticancer agents, such as reduction of oxidative damage and inflammation (Sejal 2016). The anti-tumor/anti-cancer activities of several medicinal plants have been reported by various authors (Table 1).

Among those plants, few notable ones include: *Abrus precatorious* (ghungchi), *Aglaia roxburghiana* (priyangu), *Cassia fistula*, *Catharanthus roseus* (sadabahar), *Crocus sativus* (saffron), *Ervatamia heyneana*, *Hygrophila spinosa* (talmakhana), *Hippocratea murcantha*, *Indigofera mysorensis*, *Ocimum sanctum* (tulsi), *Olea polygama*, *Plumbago rosea* (chitra), *Podophyllum hexandrum*, *Semecarpus anacardium* (bhela), *Solanum dulcamara*, *S. indicum* (barhanta), *S. khasianum*, *S. surattense* (kateli), *Terminalia arjuna* (arjuna), *Trigonella foenumgraecum* (methi), *Vanda parviflora*, *Wedelia calendulacea* (pila bhangra), *Withania somnifera* (ashwagandha) and *Zingiber capitatum*.

Table 1. Enumeration of ethnomedicinal plants for the traditional treatment of cancer/tumor and diabetes.

S.N.	Plant species and family	Common name	Parts used and ethnomedicinal uses	References
1.	*Abelmoschus esculentus* (L.) Moench. [Malvaceae]	Bindi	Fruits: diabetes	Shrestha and Pandit (2018)
2.	*Abrus precatorius* L. [Fabaceae]	Ratigedi	Leaves: diabetes	Joshi (2011)
3.	*Achyranthes aspera* L. [Amaranthaceae]	Datiwan	Whole plant: diabetes	Shrestha and Pandit (2018)
4.	*Acmella calva* (DC.) R.K. Jansen. [Asteraceae]	Marathi	Whole plant: diabetes	Shrestha and Pandit (2018)
5.	*Aconitum ferox* Wall. ex Ser. [Ranunculaceae]	Seto bish	Roots, tuber: diabetes	Bhattarai (2017)
6.	*Acorus calamus* L. [Acoraceae]	Bojho	Rhizomes, whole plant: cancer	Kunwar *et al.* (2009)
7.	*Adiantum caudatum* L. [Pteridaceae]	Unyu, Seto sinki	Whole plant: diabetes	Joshi (2011)
8.	*Aegle marmelos* (L.) Corrêa [Rutaceae]	Bel	Leaves, fruits: diabetes	Shrestha and Pandit (2018)
9.	*Allium cepa* L. [Amaryllidaceae]	Pyaz	Leaves, bulbs: diabetes, cancer	Singh (2017)
10.	*Allium sativum* L. [Amaryllidaceae]	Lasun	Leaves, bulbs: diabetes	Batiha (2020)
11.	*Amomum subulatum* Roxb. [Zingiberaceae]	Alainchi	Fruits: diabetes	Singh (2017)
12.	*Aloe vera* (L.) Burm.f. [Asphodelaceae]	Gheu kumari	Leaves: diabetes, cancer	Shrestha and Pandit (2018), Maharjan *et al.* (2021)
13.	*Argyreia nervosa* (Burm.f.) Bojer [Convolvulaceae]	Samundra phal	Aerial parts, seeds, bark, roots, leaves: diabetes	Singh and Kunwar (2017)
14.	*Aristolochia indica* L. [Aristolochiaceae]	Ishaharmool	Roots: diabetes	Singh and Kunwar (2017)
15.	*Artemisia dubia* Wall. ex Besser [Asteraceae]	Titepati	Leaves: diabetes	Shrestha and Pandit (2018)
16.	*Asparagus racemosus* Wild. [Asparagaceae]	Kurilo	Rhizomes, buds, twigs, stems: diabetes, cancer	Rai (2003), Shrestha and Pandit (2018), Kamat *et al.* (2000)
17.	*Azadirachta indica* A.Juss. [Meliaceae]	Neem	Leaves, bark: diabetes	Shrestha and Pandit (2018)
18.	*Bauhinia variegata* L. [Fabaceae]	Koiralo	Flowers: diabetes	Shrestha and Pandit (2018)
19.	*Berberis asiatica* Roxb. ex DC. [Berberidaceae]	Chutro	Roots: diabetes	Shrestha and Pandit (2018)
20.	*Bergenia ciliata* (Haw.) Sternb. [Saxifragaceae]	Pakhanbed	Rhizomes: diabetes, cancer	Kamat *et al.* (2009), Shrestha and Pandit (2018)
21.	*Bergera koenigii* L. (syn.: *Murraya koenigii* (L.) Spreng.) [Rutaceae]	Kari patta	Leaves: diabetes	Kunwar *et al.* (2009)
22.	*Buddleja asiatica* Lour. [Scrophulariaceae]	Bhimsen pati	Roots, leaves: cancer	Rai (2003)
23.	*Butea monosperma* (Lam.) Kentze [Fabaceae]	Palaash	Stem bark: diabetes	Singh *et al.* (2011)
24.	*Calamus erectus* Roxb. [Arecaceae]	Viagra palm	Roots: diabetes	Singh and Kunwar (2017)
25.	*Calotropis gigantea* (L) W.T.Aiton [Apocynaceae]	Aank	Flowers: cancer	Kunwar *et al.* (2009)
26.	*Capsicum annuum* L. [Solanaceae]	Akabare khursani	Fruits: diabetes	Shrestha and Pandit (2018)
27.	*Carum carvi* L. [Apiaceae]	Siah jira	Seeds, fruits: cancer	Singh (2017)
28.	*Cassia fistula* L. [Fabaceae]	Rajbriksha	Fruits: diabetes	Shrestha and Pandit (2018)
29.	*Catharanthus roseus* (L.) G.Don [Apocynaceae]	Sadabahar	Whole plant: diabetes, cancer	Rai (2004), Tamang *et al.* (2017), Maharjan *et al.* (2021)
30.	*Choerospondias axillaris* (Roxb.) B.L.Burtt & A.W.Hill [Anacardiaceae]	Lapsi	Fruits: diabetes	Shrestha and Pandit (2018)
31.	*Cinnamomum tamala* (Buch.-Ham.) T.Nees. & C.H.Eberm. [Lauraceae]	Tejpat, Sinkauli	Bark, leaves: diabetes	Bhattarai (2017)
32.	*Cinnamomum verum* J.Presl (syn.: *Cinnamomum zeylanicum* Blume) [Lauraceae]	Dalchini	Bark: diabetes	Singh (2017)
33.	*Clematis tibetana* Kuntze [Ranunculaceae]	Clematis	Leaves, stems, flowers: tumors	Lama *et al.* (2001)
34.	*Cirsium verutum* (D.Don) Spreng. [Asteraceae]	Thakailo	Roots: diabetes	Shrestha and Pandit (2018), Adhikari *et al.* (2019)

S.N.	Plant species and family	Common name	Parts used and ethnomedicinal uses	References
35.	*Coccinia grandis* (L.) J.Voigt [Cucurbitaceae]	Golkankri, Kunaroo	Leaves: diabetes	Singh and Kunwar (2017)
36.	*Crateva unilocularis* Buch.-Ham. [Capparaceae]	Siplikan	Young leaves, tender shoots: diabetes	Shrestha and Pandit (2018)
37.	*Crinum asiaticum* L. [Amaryllidaceae]	Seashore lily	Flowers: diabetes	Acharya and Pokharel (2006)
38.	*Cucurbita maxima* Duchesne [Cucurbitaceae]	Pharsi	Fruits: diabetes	Shrestha and Pandit (2018)
39.	*Cuscuta reflexa* Roxb. [Convolvulaceae]	Taro lahara	Whole plant: cancer	Tamang *et al.* (2017)
40.	*Curcuma longa* L. [Zingiberaceae]	Besar, Haldi	Rhizome: diabetes	Singh (2017)
41.	*Cynoglossum zeylanicum* (Sw. ex Lehm.) Thunb. ex Brand [Boraginaceae]	Nema jarma	Leaves, stems, flowers, fruits: tumors	Lama *et al.* (2001)
42.	*Cyperus esculentus* L. [Cyperaceae]	Mothe	Tubers: diabetes, cancer	Maharjan *et al.* (2021)
43.	*Dioscorea bulbifera* L. [Dioscoreaceae]	Bhyakur	Fruits: diabetes	Khadayat *et al.* (2020)
44.	*Elephantopus scaber* L. [Asteraceae]	Sahasra buti, Buti jhar	Leaves: diabetes	Joshi (2011)
45.	*Elettaria cardamomum* (L.) Maton [Zingiberaceae]	Sukumel, Syano alaichi	Seeds: cancer	Singh (2017)
46.	*Erigeron annuus* (L.) Desf. [Asteraceae]	Phuntha	Leaves, flowers: diabetes	Maharjan *et al.* (2021)
47.	*Erythrina stricta* Roxb. [Fabaceae]	Parijat	Flowers, bark: diabetes	Aryal *et al.* (2016)
48.	*Euphorbia peplus* L. [Euphorbiaceae]	Abhijalo	Flowers, leaves: cancer	Maharjan *et al.* (2021)
49.	*Ficus benghalensis* L. [Moraceae]	Bar	Leaves, bark: diabetes	Rai (2003), Acharya and Acharya (2009)
50.	*Ficus racemosa* L. [Moraceae]	Dumri	Fruits: diabetes	Joshi (2011)
51.	*Ficus religiosa* L. [Moraceae]	Peepal	Root, bark: diabetes	Joshi (2011)
52.	*Girardinia diversifolia* (Link) Friis [Urticaceae]	Ma nelau, Sisno	Bark, growing buds: diabetes	Malla *et al.* (2013), Tamang *et al.* (2017), Shrestha and Pandit (2018)
53.	*Glycine max* (L.) Merr. [Fabaceae]	Bhatmas	Seeds: diabetes	Rai (2003)
54.	*Gymnema sylvestre* (Retz.) R.Br. ex Sm. [Apocynaceae]	Gudmaar	Leaves: diabetes	Shrestha and Pandit (2018)
55.	*Hippophae salicifolia* D.Don [Elaeagnaceae]	Tarbu, Dale chuk, Ashuka	Fruits: diabetes	Lama *et al.* (2001)
56.	*Holarrhena pubescens* Wall. ex G.Don [Apocynaceae]	Indrajau	Seeds, leaves: diabetes	Shrestha and Pandit (2018)
57.	*Holoptelea integrifolia* (Roxb.) Planch.[Ulmaceae]	Kanju, Sano pangro	Leaves: diabetes	Kadhayat (2020)
58.	*Ipomoea aquatica* Forssk. [Convolvulaceae]	Kalmi saag, Paani saag	Leaves: diabetes	Joshi (2011)
59.	*Justicia adhatoda* L. [Acanthaceae]	Asuro	Leaves: diabetes	Shrestha and Pandit (2018)
60.	*Kalanchoe integra* (Medik.) Kuntze (syn.: *Kalanchoe spathulata* DC.) [Crassulaceae]	Ajammari	Leaves: diabetes	Shrestha and Pandit (2018)
61.	*Kalanchoe pinnata* (Lam.) Pers. (syn.: *Bryophyllum pinnatum* (Lam.) Oken) [Crassulaceae]	Patthar chatta	Leaves: diabetes	Maharjan *et al.* (2020)
62.	*Leucas cephalotes* (Roth) Spreng. [Lamiaceae]	Gumma	Flowers: diabetes	Singh *et al.* (2012)
63.	*Madhuca longifolia* (L.) J.F.Macbr. [Sapotaceae]	Mahuwa	Bark: diabetes	Malla and Chhetri (2009)
64.	*Melastomastrum capitatum* (Vahl) A.Fern. & R.Fern. (syn.: *Melastoma capitatum* Vahl [Melastomataceae]	Angeri	Whole plant: cancer	Maharjan *et al.* (2021)
65.	*Mirabilis jalapa* L. [Nyctaginaceae]	Setomalati	Rhizome: diabetes	Adhikari *et al.* (2019)
66.	*Momordica charantia* L. [Cucurbitaceae]	Tite Karela	Fruits: diabetes	Shrestha and Pandit (2018)

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67.	*Momordica dioica* Roxb. ex Willd. [Cucurbitaceae]	Bankarela	Fruits: diabetes	Singh and Kunwar (2017)
68.	*Musa x paradisiaca* L. [Musaceae]	Kera	Fruits: diabetes	Shrestha and Pandit (2018)
69.	*Mussaenda macrophylla* Wall. [Rubiaceae]	Dhobini	Root: diabetes	Shrestha and Pandit (2018)
70.	*Myrica esculenta* Buch.-Ham. ex D.Don [Myricaceae]	Ban kaafal	Bark: diabetes	Adhikari *et al.* (2019)
71.	*Nardostachys jatamansi* (D.Don) DC. (syn.: *Nardostachys grandiflora* DC. [Caprifoliaceae]	Jatamansi	Rhizome, leaves: tumours	Lama *et al.* (2001)
72.	*Neopicrorhiza scrophulariiflora* (Pennel) D.Y.Hong [Plantaginaceae]	Kutki	Rhizome: diabetes	Kunwar *et al.* (2009), Manandhar *et al.* (2011)
73.	*Nephrolepis cordifolia* C.Presl [Polypodiaceae]	Paani amalaa	Tuber: diabetes	Adhikari *et al.* (2019)
74.	*Nyctanthes arbor-tristis* L. [Oleaceae]	Parijat	Twig, flowers: diabetes	Shrestha and Pandit (2018)
75.	*Ocimum tenuiflorum* L. [Lamiaceae]	Tulsi	Leaves: diabetes	Shrestha and Pandit (2018)
76.	*Ophiocordyceps sinensis* (Berk.) G.H. Sung, J.M. Sung, Hywel-Jones & Spatafora (syn.: *Cordyceps sinensis* (Berk.) Sacc.) [Ophiocordycipitaceae]	Yartsagunbu	Whole organism: tumors	Kunwar and Bussmann (2009)
77.	*Opuntia monacantha* Haw. [Cactaceae]	Mayanchu	Fruits: diabetes	Tamang *et al.* (2017)
78.	*Origanum vulgare* L. [Lamiaceae]	Kodo	Seeds: diabetes	Shrestha and Pandit (2018)
79.	*Oroxylum indicum* (L.) Kurz [Bignoniaceae]	Tatelo	Stem bark, flowers, seeds: diabetes	Bhattarai (2017)
80.	*Paraquilegia microphylla* (Royle) J.R.Drumm. & Hutch. [Ranunculaceae]	Yumo deu jin	Stem, leaves, flowers: tumors	Lama *et al.* (2001)
81.	*Paris polyphylla* Sm. [Melanthiaceae]	Satuwaa	Whole plant: diabetes, cancer	Shrestha and Pandit (2018), Shrestha *et al.* (2016)
82.	*Pontederia crassipes* Mart. (syn.: *Eichhornia crassipes* (Mart.) Solms) [Pontederiaceae]	Jaluka	Leaves: diabetes	Khanal *et al.* (2020)
83.	*Fagopyrum esculentum* Moench [Polygonaceae]	Phaapar	Seeds: diabetes	Shrestha and Pandit (2018)
84.	*Pedicularis punctata* Decne. [Orobanchaceae]	Lugru mugpo, Mishran	Inflorescence: cancer	O'Neill and Rana (2016)
85.	*Phyllanthus emblica* L. [Phyllanthaceae]	Amalaa	Fruits, bark: diabetes	Shrestha and Pandit (2018)
86.	*Phyllanthus virgatus* G.Forst. [Phyllanthaceae]	Bhuiamalaa	Fruits: diabetes	Shrestha and Pandit (2018)
87.	*Pterocarpus marsupium* Roxb. [Fabaceae]	Bijayasaal	Wood: diabetes	Singh *et al.* (2018)
88.	*Psidium guajava* L. [Myrtaceae]	Ambaa	Leaves, fruits, twig: diabetes	Shrestha and Pandit (2018)
89.	*Punica granatum* L. [Lythraceae]	Anaar	Bark: diabetes	Shrestha and Pandit (2018)
90.	*Ranunculus brotherusii* Freyn [Ranunculaceae]	Chetsaa, Chu rugpaa	Leaves, flowers, stem: tumours	Lama *et al.* (2001)
91.	*Rhododendron arboreum* Sm. [Ericaceae]	Laliguraans	Flowers, leaves, bark: diabetes	Shrestha and Pandit (2018)
92.	*Ricinus communis* L. [Euphorbiaceae]	Adir	Seeds, leaves, stalk, fruits: diabetes	Maharjan *et al.* (2021)
93.	*Rubus ellipticus* Sm. [Rosaceae]	Ainselu	Bud, root: diabetes	Adhikari *et al.* (2019)
94.	*Saccharum officinarum* L. [Poaceae]	Ukhu	Stem: diabetes	Shrestha and Pandit (2018)
95.	*Salvia splendens* Sellow ex Nees [Lamiaceae]	Sachika swan	Flowers: diabetes	Ranjitkar and Rajbhandari (2008)
96.	*Saraca asoca* (Roxb.) W.J.de Wilde [Fabaceae]	Ashok	Flowers: diabetes	Kadhayat *et al.* (2020)
97.	*Scoparia dulcis* L. [Plantaginaceae]	Chini jhaar	Whole plant: diabetes	Tamang *et al.* (2017), Shrestha and Pandit (2018)
98.	*Semecarpus anacardium* L.f. [Anacardiaceae]	Bhalaayo	Plant, nuts: cancer	Kunwar *et al.* (2009)
99.	*Senegalia catechu* (L.f.) P.J.H.Hurter & Mabb. (syn.: *Acacia catechu* (L.f.) Wild.) [Fabaceae]	Khayar	Leaves, shoots, wood: diabetes	Khadayat *et al.* (2020)

S.N.	Plant species and family	Common name	Parts used and ethnomedicinal uses	References
100.	*Sesamum indicum* L. [Pedaliaceae]	Til	Dried seeds: diabetes	Gupta *et al.* (2010), Kabir *et al.* (2017)
101.	*Shorea robusta* C.F.Gaertn. [Dipterocarpaceae]	Saal	Seeds: diabetes	Shrestha and Pandit (2018)
102.	*Sicyos edulis* Jacq. (syn.: *Sechium edule* (Jacq.) Sw.) [Cucurbitaceae]	Iskus	Young shoot: diabetes	Bhattarai (2017)
103.	*Sophora mollis* (Royle) Graham ex Baker [Fabaceae]	Chunnjado	Root: tumours	Kunwar and Bussmann (2009)
104.	*Swertia chirayita* (Roxb.) H.Karst. (syn.: *Swertia chirata* Buch.-Ham. ex Wall.) [Gentianaceae]	Chiraayita	Whole plant: diabetes, cancer	Kumar and Standen (2016), Bhattarai (2017)
105.	*Swertia purpurascens* (D.Don) C.B.Clarke (syn.: *Swertia ciliata* (D.Don) B.L.Burtt) [Gentianaceae]	Tiktaa	Whole plant: diabetes	Gewali (2008)
106.	*Swertia racemosa* (Griseb.) Wall. Ex C.B.Clarke [Gentianaceae]	Lakh tiktaa	Whole plant: diabetes	Gewali (2008)
107.	*Syzygium cumini* (L.) Skeels [Myrtaceae]	Jaamun	Fruits, seeds: diabetes	Shrestha and Pandit (2018)
108.	*Syzygium nervosum* DC. (syn.: *Cleistocalyx operculatus* (Roxb.) Merr. & L.M.Perry) [Myrtaceae]	Kyaamuna	Bark, leaves: diabetes	Tamang *et al.* (2017)
109.	*Taxus contorta* Griff. [Taxaceae]	Lothsallaa	Leaves, bark: cancer	Joshi *et al.* (2017)
110.	*Taxus wallichiana* Zucc. [Taxaceae]	Lothsallaa	Leaves, bark: cancer	Malla (2015), Bhattarai (2017)
111.	*Terminalia bellirica* (Gaertn.) Roxb. [Combretaceae]	Barro	Fruits: diabetes	Shrestha and Pandit (2018)
112.	*Terminalia chebula* Retz. [Combretaceae]	Harro	Fruits: diabetes	Shrestha and Pandit (2018)
113.	*Tinospora sinensis* (Lour.) Merr. [Menispermaceae]	Gurjo	Whole plant, stem: diabetes	Bhattarai (2017), Shrestha and Pandit (2018)
114.	*Trigonella foenum-graecum* L. [Fabaceae]	Methi	Leaves, seeds: diabetes, cancer	Singh (2017), Wani *et al.* (2018)
115.	*Triticum aestivum* L. [Poaceae]	Gahun	Aerial parts: diabetes	Shrestha and Pandit (2018)
116.	*Urtica ardens* Link. [Urticaceae]	Ghariyaa sisnu	Root, young shoot, leaves: diabetes	Bhattarai (2017)
117.	*Urtica dioica* L. [Urticaceae]	Nelau, Sisnu	Leaves, root: diabetes	Tamang *et al.* (2017)
118.	*Vanda testacea* (Lindl.) Rchb.f. [Orchidaceae]	Small flower Vanda	Leaves: cancer	Joshi *et al.* (2017)
119.	*Vitex negundo* L. [Lamiaceae]	Simali	Whole plant: cancer, diabetes	Shrestha and Pandit (2018)
120.	*Woodfordia fruticosa* (L.) Kurz [Lythraceae]	Tamra pushpin	Bark: diabetes	Kunwar *et al.* (2009)
121.	*Zanthoxylum armatum* DC. [Rutaceae]	Timur	Bark: diabetes	Kunwar *et al.* (2009)
122.	*Zea mays* L. [Poaceae]	Makai	Fruits, seeds: diabetes	Shrestha and Pandit (2018)
123.	*Zephyranthes carinata* Herb. [Amaryllidaceae]	Rain lily	Leaves, bulbs: cancer	Maharjan *et al.* (2021)
124.	*Zingiber officinale* Roscoe [Zingiberaceae]	Aduwaa	Root: diabetes	Shrestha and Pandit (2018)
125.	*Ziziphus mauritiana* Lam. [Rhamnaceae]	Bayar	Fruits, leaves: diabetes	Tamang *et al.* (2017)

Diabetes is a serious metabolic disorder and is the third leading cause of death globally, preceded only by cancer and coronary heart disease. Among 7.7 billion total populations (2019), around 463 million adults have diabetes, with a global prevalence of 9.3% and may rise to 10.9% by 2045. In 2019, the prevalence rate of diabetes in Nepalese adults was observed to be 4% and accounted for approximately 696,900 sufferings and 11,700 adult deaths due to diabetes. It is posing a serious economic burden to both the developed and developing nations; therefore, it is imperative to identify a cost-effective treatment with wider accessibility (Saini and Parkashyadav 2013). Diabetes cannot be cured with allopathic drugs, as these drugs are unable to restore normal glucose balance and carry a host of negative side effects. There is an urgent need for alternative medicines that are more effective, affordable, and carry fewer side effects (Einstein *et al.* 2013). Herbal medicines have been used for the treatment of diabetic patients for since long time, and they are currently accepted as an alternative therapy for diabetic treatment. WHO (1980) has also recommended the evaluation of the effectiveness of plants in conditions where there are no safe modern drugs. The ethnobotanical information reports state that about 800 plants may possess antidiabetic potential (Joshi

2011; Saini and Parkashyadav 2013; Sejal 2016). Recently, the medicinal values of various plants have been studied by many scientists in the field of diabetic research.

Ethnomedicinal plants having antidiabetic properties (see Table 1) can provide a useful alternative source for the development of safer and effective oral hypoglycemic agents. Presently, among the documented 125 plant species, 76% of them are used for the treatment of diabetes. Around the world, more than 1,200 species of plants have been identified with hypoglycemic activity (Joshi 2011; Saini and Parkashyadav 2013). Six ethnomedicinal plants: *Gymnema sylvestre*, *Momordica charantia*, *Syzygium cumini*, *Pterocarpus marsupium*, *Trigonella foenumgraecum*, and *Cinnamomum tamala* were evaluated for their activity against platelet dysfunction associated with diabetes. The most frequently used anti-diabetic plants in many countries are *Allium sativum*, *Eugenia jambolana*, *Momordica charantia*, *Trigonella foenumgraecum*, *Coccinia indica*, *Azadirachta indica*, and *Punica granatum*. Herbal practitioners across the world claim to treat diabetes with medicinal plants, and recently, herbs have gained the attention of the medical community as a reliable source of diabetic medicines (Rahmatullah *et al.* 2012; Chattopadhyay 2003; Jeong *et al.* 2012). Different pharmaceutical products used in the treatment of diabetes are derived from compounds of plant origin. Traditional medicines possess strong therapeutic properties and have markedly lower toxicity than allopathic drugs. *Azadirachta indica*, *Carum carvi*, *Tinospora sinensis*, *Vitex negundo*, *Acacia catechu*, *Ficus religiosa*, *Cirsium verutum*, *Mirabilis jalapa*, *Myrica esculenta*, *Nephrolepis cordifolia*, *Rubus ellipticus*, *Zea mays*, *Asparagus racemosus*, and *Aloe vera* are the most common and potent antidiabetic medicinal plants traditionally used in Nepal (Kunwar *et al.* 2010; Adhikari *et al.* 2019; Giri *et al.* 2023).

Conclusions

A total of 125 plant species belonging to 72 families have been used in Nepal for the treatment of diabetes and cancer. It is necessary to conduct bioprospecting and phytochemical analyses, including the identification and isolation of active compounds for new drugs. Moreover, regulating collection, assessing conservation status, and documenting traditional use practices are necessary steps forward. Traditional knowledge of the indigenous uses of medicinal plants could boost innovation in the pharmaceutical industry and have many beneficial applications, such as new trials for pernicious diseases, including cancer and diabetes, job opportunities, and income generation.

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