PLANT SCIENCE TODAY
ISSN 2348-1900 (online)
Vol x(x): xx–xx
https://doi.org/10.14719/pst.4194

HORIZON
e-Publishing Group
HePG

REVIEW ARTICLE

Eternal wellness: Anti-ageing herbs of the Sikkim Himalayas

Abishek Adhikari*, Anurag Neopaney, Chowang Norbu Bhutia, Anish Pradhan & Sonam Bhutia*

*Government Pharmacy College Sajong, Government of Sikkim, Sikkim University, Rumtek, Sajong, Gangtok district 737 135

*Email: sonamkzbhutia@gmail.com

OPEN ACCESS

ARTICLE HISTORY
Received: 27 June 2024
Accepted: 06 September 2024
Available online
Version 1.0 : 12 January 2025

Check for updates

Additional information
Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

Reprints & permissions information is available at https://horizonepublishing.com/journals/index.php/PST/open_access_policy

Publisher's Note: Horizon e-Publishing Group remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Indexing: Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS, UGC Care, etc
See https://horizonepublishing.com/journals/index.php/PST/indexing_abstracting

CITE THIS ARTICLE
Adhikari A, Neopaney A, Bhutia CN, Pradhan A, Bhutia S. Eternal wellness: Anti-ageing herbs of the Sikkim Himalayas. Plant Science Today (Early Access). https:/doi.org/10.14719/pst.4194

Abstract

This review paper delves into the anti-ageing potential of herbs from the Sikkim Himalayas, highlighting their significance in promoting overall well-being. Through a comprehensive literature review and targeted searches, we identified and analysed fifteen prominent anti-ageing herbs, such as *Rhodiola rosea*, *Curcuma longa* and *Cordyceps sinensis*. Given the projected growth of the global anti-ageing market to US$71.6 billion in 2023, there is an increasing demand for natural, plant-based solutions. Our findings emphasize the practical applications of these herbs, discussing methods for integrating them into daily life and their potential health benefits. The review also notes roots were the most utilized plant part, followed by leaves. In terms of family distribution, the Zingiberaceae and Fabaceae families each accounted for 13 % of the identified herbs. This study underscores the importance of further exploration into the medicinal and anti-ageing properties of Sikkim's herbal flora, offering insights for future research and the development of natural health products to foster longevity and wellness.

Keywords

anti-ageing herbs; eternal wellbeing; lifestyle; medicinal plants; Sikkim Himalaya

Introduction

Ageing is a natural, continuous process that begins at birth and progresses throughout life. Simply put, it involves the gradual decline of bodily functions as individuals grow older and more mature (1). With the current increase in life expectancy, it is estimated that by 2025, over 1.2 billion people worldwide will be over the age of 65 (2). As a result, maintaining physical well-being and a youthful appearance has become a priority for many. The most noticeable signs of ageing appear on the skin, with wrinkles and age spots forming due to thinning and reduced elasticity. Physical activity often declines with age as body functions deteriorate and ageing is a significant risk factor for several human diseases and disorders (3). India, recognized as one of the 12 megadiverse countries in the world, holds a wealth of biodiversity. The Himalayan region, in particular, is known for its rich and unique flora and fauna, shaped by its diverse geography, topography and climatic zones. This biodiversity plays a key role in ongoing research on health and ageing.

Sikkim, located in the northeastern region of India and occupying only 0.2 % of the country's geographical area, is recognized as a biodiversity hotspot in the Eastern Himalayas. The region is home to approximately 490 medicinal plant species (4), many of which have been traditionally used by the ethnic communities of Sikkim, including the Lepchas, Bhutias and Nepalis. This indigenous medicinal knowledge has been passed down orally through generations, but with the growing dominance of modern medicine, this traditional knowledge is at risk of being lost as elder healers pass away without proper documentation (5,6). Sikkim, a small yet ecologically diverse state, spans

an area of 7069 km^2 and rises from 300 to 8568 m above sea level. The state's rich biodiversity, coupled with its unique geography, has earned it recognition as a critical biodiversity hotspot (7). The objective of this review is to document and raise awareness of the anti-ageing properties of various medicinal herbs found in the Sikkim Himalayas. Despite the abundance of such herbs, many residents remain unaware of their potential benefits, as modern medicine has become the more prevalent healthcare option. By compiling and analyzing scientific data on these herbs, we aim to preserve this valuable knowledge and promote its use in both traditional and modern therapeutic practices.

Materials and Methods

We conducted a comprehensive literature search using online scientific databases such as PubMed, Science Direct, Research Gate and Google Scholar. In the initial phase, broad search terms like "ANTI-AGEING HERBS" and "HERBAL AGEING SOLUTIONS" were employed to gain a general understanding of the subject. Following this, the search was narrowed to focus on anti-ageing herbs, with a specific emphasis on those found in the Sikkim Himalayas. The search was restricted to articles published within the last 25 years to ensure the relevance of the data. The present study aims to explore plants with anti-ageing properties endemic to the Sikkim Himalayas. Given the limited research available from this specific region, the scope of relevant literature was relatively narrow. To refine the search and optimize results, Boolean operators such as "AND," "OR" and "NOT" were employed. For instance, "AND" was used to combine key terms, such as "anti-ageing AND herbs AND Sikkim," while "OR" helped gather articles containing any one of several specified terms, like "ANTI-AGEING" OR "AGEING ENHANCERS" OR "HERBAL AGEING SOLUTIONS." Additionally, "NOT" was applied to exclude irrelevant topics, such as "NOT SYNTHETIC REMEDIES" and "NOT COSMETIC PRODUCTS." This targeted approach helped streamline the search process, ensuring the selection of the most relevant studies. For example, search strings like "ANTI-AGEING HERBS" OR "HERBAL AGEING SOLUTIONS" AND "SIKKIM HIMALAYAS" NOT "SYNTHETIC DRUGS" OR "HERBS OUTSIDE SIKKIM" were particularly effective in identifying pertinent articles. As new insights were gained, the search strategy was further refined to improve precision. Key papers were selected based on their relevance to anti-ageing mechanisms, botanical importance and contributions to understanding ageing processes. Detailed follow-up searches were conducted on individual herbs to extract more specific information. Ultimately, 28 articles were deemed critical for this study based on their scientific significance and relevance to the research objectives.

Objective

Natural herbs have been utilized for centuries in the prevention and treatment of skin ageing and recent scientific interest has further highlighted their potential in anti-ageing therapies. Numerous strategies and methodologies have been developed to enhance the efficacy and quality of these herbs as components of anti-ageing regimens. In this paper, we aim to highlight some of the most notable medicinal herbs found in Sikkim, along with practical applications used by local communities for integrating these herbs into daily life. Out of the 490 medicinal plants identified; we focus on 15 key herbs renowned for their anti-ageing properties. These include *Cordyceps sinensis*, *Withania somnifera*, *Glycyrrhiza glabra*, *Zingiber officinale*, *Curcuma longa*, *Rhodiola rosea*, *Panax ginseng*, *Tinospora cordifolia*, *Aloe barbadensis*, *Cinnamomum tamala*, *Centella asiatica*, *Mimosa pudica*, *Emblica officinalis*, *Nardostachys jatamansi* and *Malus domestica*. Each of these herbs possesses bioactive compounds known for their antioxidant, anti-inflammatory and rejuvenating effects, making them promising candidates for combating the signs of ageing. Given the rapid increase in the global ageing population, we aim to provide an in-depth understanding of how these herbs can be leveraged for anti-ageing purposes. Additionally, we offer practical suggestions for integrating these herbs into daily routines, either through dietary incorporation or through the preparation of natural remedies. Our aim is to promote the use of these herbs as a natural, effective approach to enhancing skin health and vitality, empowering individuals to adopt these age-old practices for healthier, more vibrant living.

Statistics

For the inclusion of better data presentation, we have used Microsoft Excel 2013 for the creation of graphical presentations within the manuscript.

Results

The findings of the present short review are summarized in Table 1.

Discussion

Ageing is a multifaceted and progressive biological phenomenon influenced not only by intrinsic genetic factors but also by extrinsic elements, such as an imbalanced diet and an unhealthy lifestyle. In recent years, the use of anti-ageing therapies has gained prominence, particularly in the context of medicinal plants, for their role in enhancing longevity and mitigating the effects of ageing. This review explores several anti-ageing herbs endemic to the biodiverse region of Sikkim, located in the Himalayas. The Sikkim Himalayas, with their rich biodiversity, host approximately 490 medicinal plants, of which a select few have demonstrated significant anti-ageing properties. This review highlights 15 notable ethno-medicinal herbs from Sikkim, distributed across 13 botanical families (Fig. 2). These herbs are detailed in Table 1, representing 15 genera, with Zingiberaceae and Fabaceae contributing 13 % each to the total. Other significant families include Apiaceae, Araliaceae, Menispermaceae, Solanaceae, Asphodelaceae, Lauraceae and Crassulaceae, each representing 7 %. The primary plant parts used for anti-ageing purposes are roots (33 %), followed by leaves (20 %), fruits and rhizomes (13 %), with a smaller contribution from stems, bark and whole plants (6 %) (Fig. 1). In comparison to previous studies, such as (29) which identified anti-ageing properties in *Cymbopogon* species (Poaceae), the present review expands the understanding of medicinal plants in the Sikkim Himalayas. Additionally, discussed the inclusion of plants such as *Cocos nucifera*, *Helianthus annuus* and *Daucus carota* in nano-herbal

Table 1. Ethno-medicinal plants used as anti-ageing in Sikkim Himalayas.

Sl. No.	Vernacular / local name	Scientific name/Family	Part used	Uses as anti-ageing herbs	Other uses	Method to incorporate in daily lives	References
1.	Yarsagumbhu	*Cordyceps sinensis* Family- Ophiocordycipitaceae	Whole plant	Retard ageing process in immune system.	Rejuvenate liver and heart, fertility enhancer, etc.	Take 1-2 pieces of *C. sinensis* with a cup of milk. Soak in water or alcohol overnight and drink it in the	(2, 5, 6)
2.	Ashwagandha	*Withaniasomnifera* Family- Solanaceae	Root	Acts as an immunomodulator.	Used in treatment of cancer, anxiety, aphrodisiac, arthritis, stress, sexual dysfunction, etc.	The powdered root can be taken orally, with honey or water. After digesting it with water we can drink it.	(8, 10)
3.	Mulethi	*Glycyrrhiza glabra* Family- Fabaceae	Root	It acts as superoxide scavenger and prevent wrinkles.	Used as carminative, sweetner, bactericidal and fungicidal, etc.	It can be used as sweetners in cakes and cookies. Can be used as an ingredient in tea. Can be consumed as beverage in form of wine.	(3, 4, 8, 11)
4.	Adhuwa/Ginger	*Zingiber officinale* Family- Zingiberaceae	Rhizome	Either increase or suppress the immune system.	Anti-inflammatory, antihyperglycemic, antilipedemia and used as a homemade remedy in case of nausea vomiting and diarrhea, etc.	Can be taken with tea. It is easily incorporated as spices in pulses and some vegetables.	(8, 14)
5.	Haldi	*Curcuma longa* Family- Zingiberaceae	Rhizome	Curcumin as superoxide scavenger and as a singlet oxygen quencher.	Anti-cancerous, anti-inflammatory and antioxidant, etc.	Easy to incorporate through vegetables. Can be taken with milk.	(3, 4)
6.	Golden root/ rose root	*Rhodiola rosea* Family- Crassulaceae	Root	It protects against free-radical oxidative damage in human red blood cells.	Anti stress, anti-cancer, anti-inflammatory, etc.	The tincture or extract of golden root can be taken before sleep.	(12, 13)
7.	Ginseng	*Panax ginseng* Family- Araliaceae	Root	Ginsenoside present in Ginseng improves blood circulation and skin tone and also moisturizes the skin.	Used in case of anxiety, fatigue, stress and trauma.	The root powder can be taken with water. It can also be consumed in the form of tea.	(3, 4, 15)
8.	Gurjo	*Tinospora Cordifolia* Family- Menispermaceae	Stem	It acts as an immunomodulatory.	Used as hepatoprotective, anti-inflammatory and antineoplastic, etc.	The stem juice of Guduchi can be mixed with other juices. The powder of Guduchi can be taken with jaggery.	(9, 16)
9.	Ghew Kumari/ *Aloe vera*	*Aloe barbadensis* Family- Asphodelaceae	Leaf	antioxidant, moisturizer, protection from UV rays, prevent wrinkles.	also used in wounds, swelling, fever, immunological stimulation, anticancer, antibacterial, antiviral, etc.	It can be applied topically or can be used in health beverages	(3, 17)
10.	Dalchini/ Cinnamon	*Cinnamomum tamala* Family- Lauraceae	Bark	It prevents breakdown of collagen and is a good antioxidant and elastase inhibitor.	Used in treating chronic bronchitis, antifertility. Also, as anti-inflammatory and wound healer.	The bark can be used as a spice while cooking and it serves as a great flavouring agent.	(18, 19)
11.	Golpata/aathini jhar/Gotu kola/ Indian penny wort	*Centella asiatica* Family- Apiaceae	Leaf	It protects form UV radiations and used in prevention of scar, treatment of acne, etc.	Antitubercular, antileprotic,wound healing, antide-pressant, anticancer, curing gastrointestinal disorders and the diseases of the central nervous system.	It can be incorporated in tea. The leaves can be eaten with rice.	(20, 21)

12.	Lajawanthi ghas/ Touch-me-not	*Mimosa pudica* Family- Fabaceae	Leaf	It acts as an antioxidant and helps to maintain cellular health and reduce oxidative stress.	It is used to balance the blood glucose levels, heal cuts and wounds. Also, as an anti-inflammatory agent.	It can be taken in form of tea. Take a handful of the fresh leaves and pound it along with little quantity of water to get a paste and apply where you want it.	(17, 22, 23)
13.	Amla	*Emblica officinalis* Family- Phyllanthaceae	Fruit	Amla is rich in Vitamin C which acts as a free radicle scavenger.	Anti-depressant, hair tonic, anti-oxidant,anti-cancer , anti-lipidemic, anti-diabetic.	The fruit can be eaten directly. The amla powder is mixed with honey and eaten.	(3, 17, 24)
14.	Jatamansi	*Nardostachys jatamansi* Family- Caprifoliaceae	Root	Jatamansi increase the synthesis of collagen and elastin fibres, due to which skin elasticity increases and wrinkle formation decreases.	It is used in hair loss, in epilepsy and hysteria. It also possesses antibacterial, antifungal, antiviral properties.	The oil of Jatamansi could be directly applied on the skin. The root powder could be mixed with honey and water and used as a mask.	(3, 5, 17, 25)
15.	Syau/Apple	*Malus domestica* Family- Rosaceae	Fruit	It prevents wrinkle formation and provides hydration to the skin.	It can help in treatment of Asthma, acidity, arthritis, diarrhoea, fever, obesity, headache, stomach aches, skin illnesses and respiratory issues, etc.	The fruit can be eaten directly. The fruit juice can be taken with meals.	(17, 26, 27)

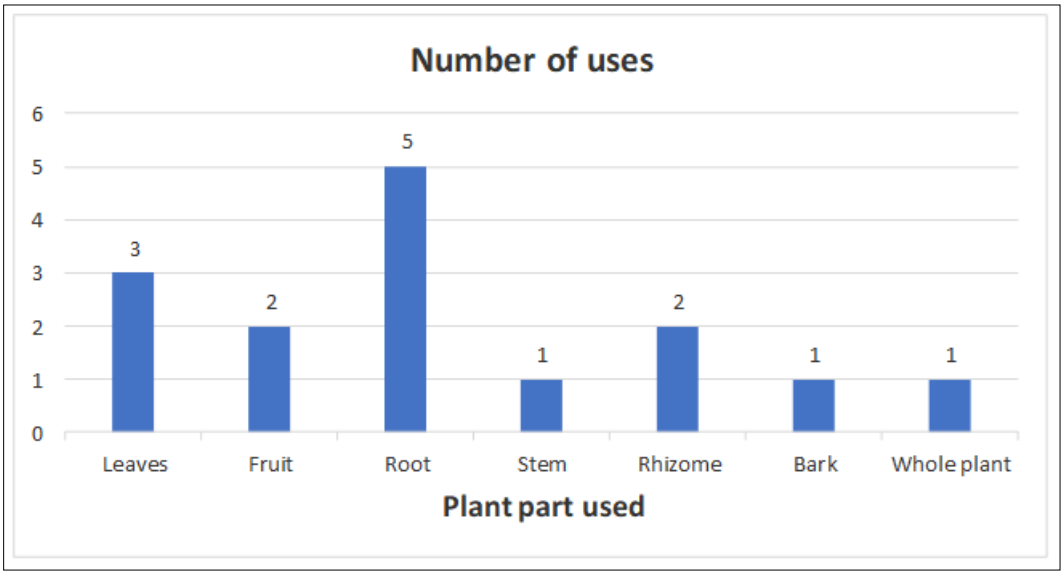

Fig. 1. Anti-ageing herbs and their part used.

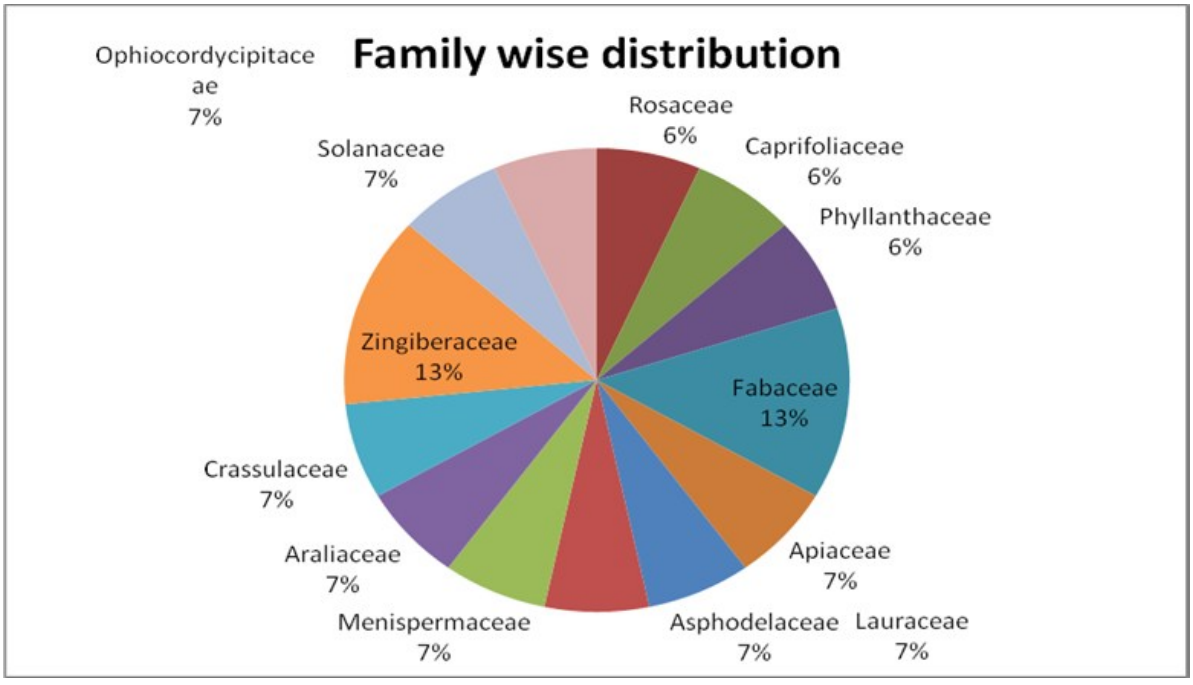

Fig. 2. The percentage wise family distribution of the anti-ageing herbs.

formulations aimed at anti-ageing applications (30). Moreover, traditional medicinal practices in the region continue to be widely employed, not only for anti-ageing purposes, but also for treating various ailments such as fever, jaundice, diabetes, asthma, leprosy, bronchitis, dysentery and menstrual disorders, among others. These practices, supported by numerous studies (31-40), underscore the therapeutic potential of Sikkim's medicinal flora for both anti-ageing and holistic health management.

Conclusion

Based on the reviewed literature, it was identified that among the 499 ethnomedicinal plants reported from the Sikkim Himalayas, 15 herbs exhibit notable potential as anti-ageing agents. Given the rapid growth of the global anti-ageing market and the increasing demand for natural remedies, these herbs hold significant promise for their therapeutic applications. In conclusion, the incorporation of these anti-ageing herbs into daily routines presents a practical approach to promoting health and longevity. Additionally, further exploration of the rich ethnobotanical knowledge from the Sikkim Himalayas could provide valuable insights for developing sustainable, plant-based solutions to meet the growing health demands of modern society.

Acknowledgements

The authors are grateful to the Health and Family Welfare Department, Government of Sikkim (GoS) and host institutes-Government Pharmacy College, Sajong, Government of Sikkim - Rumtek, Sajong, East Sikkim giving advanced facilities such as internet, sound and friendly environment facilities, etc. to collect the significant scientific online data for this review work. Funding for this present survey work is not applicable.

Authors' contributions

AA, AN and CNB responsible for the selection of the review work and major data collection by trial-and-error methods. AP and SB are responsible for the guidance of the review work till the end. SB contributed to drafting, designing, formatting and referencing this online survey article and communicating with a scientific esteemed journal that has a good reputation in the scientific field. All authors have read and approved the manuscript. All the authors have read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: The author has no conflict of interest to disclose.

Ethical issues: None

References

1. Arking R. Biology of ageing: observations and principles. Oxford University Press. 2006.
2. Kalache A, Barreto SM, Keller I. Global ageing: The demographic revolution in all cultures and societies. Cambridge University Press. 2005 . https://doi.org/10.1017/CBO9780511610714.005
3. Chettri U, Kumari S. A list of medicinally important plants of Sikkim Himalayan region, India. J Med Plants. 2021;9(4):24-27. https://doi.org/10.22271/plants.2021.v9.i4a.1307
4. Sherpa MT, Mathur A, Das S. Medicinal plants and traditional medicine system of Sikkim: a review. World Journal of Pharmacy and Pharmaceutical Sciences. 2015;4(2):161-84.
5. Chakraborty A, Sahoo M, Roy SD, Dasgupta RK. Anti-ageing natural herbs: A systemic review. Indian Research Journal of Pharmacy and Science. 2018;5(3):1589-98. https://doi.org/10.21276/irjps.2018.5.3.4
6. Dhanjal DS, Bhardwaj S, Sharma R, Bhardwaj K, Kumar D, Chopra C, et al. Plant fortification of the diet for anti-ageing effects: A review. Nutrients. 2020;12(10):3008. https://doi.org/10.3390/nu12103008
7. Hajra PK, Verma DM. Flora of Sikkim vol. 1. Botanical Survey of India; 1996.
8. Rosa F, Giuseppe C, Luca R. Ganoderma lucidum and cordyceps sinensis in anti-ageing medicine. Pharmacology Online. 2020;3:1-6.
9. Panda AK, Swain KC. Traditional uses and medicinal potential of Cordyceps sinensis of Sikkim. Journal of Ayurveda and Integrative Medicine. 2011;2(1):9. https://doi.org/10.4103/0975-9476.78183
10. Arun PP, Kumar G, Tiwari RK, Sharma B. Herbal-based medicine approach in the treatment of infertility: a review.
11. Prajwala B, Raghu N, Gopenath TS, Basalingappa KM. Guduchi: its medicinal properties. J Plant Physiol Pathol. 2019;3(2):7.
12. Mishra LC, Singh BB, Dagenais S. Scientific basis for the therapeutic use of *Withania somnifera* (Ashwagandha): a review. Alternative Medicine Review. 2000;5(4):334-46.
13. Pawar SS, Gosavi SA, Gorde PL, Harak SS, Shendge RS, Dumbare MR. Study of different parameters on formulation, phytochemical and pharmacological profile of liquorice wine. Nveo-Natural Volatiles and Essential Oils Journal. NVEO. 2021;13489-504.
14. Jafari M, Felgner JS, Bussel II, Hutchili T, Khodayari B, Rose MR, et al. *Rhodiola*: a promising anti-ageing Chinese herb. Rejuvenation Research. 2007;10(4):587-602. https://doi.org/10.1089/rej.2007.0560
15. Li Y, Pham V, Bui M, Song L, Wu C, Walia A, et al. *Rhodiola rosea* L.: an herb with anti-stress, anti-ageing and immunostimulating properties for cancer chemoprevention. Current Pharmacology Reports. 2017;3:384-95. https://doi.org/10.1007/s40495-017-0106-1
16. Shahrajabian MH, Wenli SU, Cheng Q. Pharmacological uses and health benefits of ginger (*Zingiber officinale*) in traditional Asian and ancient Chinese medicine and modern practice. Notulae Scientia Biologicae. 2019;11(3):309-19. https://doi.org/10.15835/nsb11310419
17. Ashrafizadeh M, Ahmadi Z, Mohammadinejad R, Farkhondeh T, Samarghandian S. MicroRNAs mediate the anti-tumor and protective effects of ginsenosides. Nutrition and Cancer. 2020;72(8):1264-75. https://doi.org/10.1080/01635581.2019.1675722
18. Gautam AS, Singh A, Kumar K. Analysis of therapeutic value of *Tinospora cordifolia*. Asia Pac J Multidiscip Res. 2020;8:27-41.
19. Verma A, Kumar A, Kumar R. Medicinal plants as source of anti-ageing agents: A review.
20. Ribeiro-Santos R, Andrade M, Madella D, Martinazzo AP, Moura LD, de Melo NR, Sanches-Silva A. Revisiting an ancient spice with medicinal purposes: Cinnamon. Trends in Food Science and Technology. 2017;62:154-69. https://doi.org/10.1016/j.tifs.2017.02.011
21. Wanakhachornkrai O, Banglao W, Thongmee A, Sukplang P. Determination of antioxidant, anti-ageing and cytotoxicity activity of the essential oils from *Cinnamomum zeylanicum*. Journal of Microbiology, Biotechnology and Food Sciences. 2020;10(3):436-40. https://doi.org/10.15414/jmbfs.2020.10.3.436-440
22. Theerawitaya C, Pipatsitee P, Taota K, Praseartkul P, Tisarum R, Samphumphuang T, et al. Impact of irrigation regime on morpho-

physiological and biochemical attributes and centelloside content in Indian pennywort (*Centella asiatica*). Irrigation Science. 2023;41 (1):23-34. https://doi.org/10.1007/s00271-022-00832-9

23. Kotnala A, Verma K, Sharma A, Parashar S, Rathi B, Kumar R, et al. Indian medicinal plants for skin care and cosmeceuticals: A review. Journal of Biomedical and Therapeutic Sciences. 2019;6(2):24-60.
24. Havaldar VD, Mali KK, Mali SS, Jadhav NY, Shinde SS, Shinde AA. Phytochemical and pharmacological screening of *Delonix regia*: A brief review. Journal of Pharmacognosy and Phytochemistry. 2024;13 (4):234-39. https://doi.org/10.22271/phyto.2024.v13.i4c.15014
25. Zhang J, Yuan K, Zhou WL, Zhou J, Yang P. Studies on the active components and antioxidant activities of the extracts of *Mimosa pudica* Linn. from southern China. Pharmacognosy Magazine. 2011;7(25):35. https://doi.org/10.4103/0973-1296.75899
26. Mirunalini S, Krishnaveni M. Therapeutic potential of *Phyllanthus emblica* (Amla): the ayurvedic wonder. Journal of Basic and Clinical Physiology and Pharmacology. 2010;21(1):93-105. https://doi.org/10.1515/JBCPP.2010.21.1.93
27. Wang M, Yang TT, Rao Y, Wang ZM, Dong X, Zhang LH, et al. A review on traditional uses, phytochemistry, pharmacology, toxicology and the analytical methods of the genus *Nardostachys*. Journal of Ethnopharmacology. 2021;280:114446. https://doi.org/10.1515/JBCPP.2010.21.1.93
28. Pradhan P, Dasila K, Singh M. Uses of ethnomedicinal plants by the people living around Kitam Bird Wildlife Sanctuary, South Sikkim, India. Acta Ecologica Sinica. 2022;42(4):259-68. https://doi.org/10.1016/j.chnaes.2021.09.020
29. Salsabila DU, Wardani RK, Hasanah NU, Tafrihani AS, Zulfin UM, Ikawati M, Meiyanto E. Cytoprotective properties of citronella oil (*Cymbopogon nardus* (L.) Rendl.) and lemongrass oil (*Cymbopogon citratus* (DC.) Stapf) through attenuation of senescent-induced chemotherapeutic agent doxorubicin on Vero and NIH-3T3 Cells. Asian Pacific Journal of Cancer Prevention. 2023;24(5):1667-75. https://doi.org/10.31557/APJCP.2023.24.5.1667
30. Sarma SK, Subba T, Hazra N, Pradhan A, Bhattacharjee T. Anti-ageing activity of various topical nano herbal formulations. Universal Journal of Pharmaceutical Sciences and Research. 2023;9 (1):21-27.
31. Singh HB, Prasad P, Rai LK. Folk medicinal plants in the Sikkim Himalayas of India. Asian Folklore Studies. 2002:295-310. https://doi.org/10.2307/1178975
32. Pradhan BK, Badola HK. Ethnomedicinal plant use by Lepcha tribe of Dzongu valley, bordering Khangchendzonga Biosphere Reserve, in North Sikkim, India. Journal of Ethnobiology and Ethnomedicine. 2008;4:1-8. https://doi.org/10.1186/1746-4269-4-22
33. Idrisi MS, Badola HK, Singh R. Indigenous knowledge and medicinal use of plants by local communities in Rangit Valley, South Sikkim, India. NeBIO. 2010;1(2):34-45.
34. Banik B, Das S, Das MK. Medicinal plants with potent anti-inflammatory and anti-arthritic properties found in Eastern parts of the Himalaya: An ethnomedicinal review. Pharmacognosy Reviews. 2020;14(28).
35. Bharati KA, Sharma BL. Plants used as ethnoveterinary medicines in Sikkim Himalayas. Ethnobotany Research and Applications. 2012;10:339-56. https://doi.org/10.17348/era.10.0.339-356
36. Badola HK, Pradhan BK. Plants used in healthcare practices by Limboo tribe in South–West of Khangchendzonga Biosphere Reserve, Sikkim, India.
37. Lepcha TT, Pradhan P, Gaira KS, Badola HK, Shahid M, Singh M. Ethnomedicinal use of plants by Bhutia tribe in Sikkim Himalaya. Proceedings of the Ist Himalayan Researchers Consortium. 2019;1:71-78.
38. Rai B, Bhutia S, Pal P, Kakoti BB. Phytochemical analysis and antibacterial evaluation against selected gram strains by *Oroxylum indicum* (L.) Kurz stem bark extract, a folklore medicine of Sikkim Himalaya. Journal of Pharmacognosy and Phytochemistry. 2020;9 (1):11-16.
39. Sharma A, Pal P, Sarkar BR, Mohanty JP, Bhutia S. Preparation, standardisation and evaluation of hypoglycaemic effect of herbal formulation containing five ethnomedicinal plants in alloxan-induced hyperglycemic wistar rats. Research Journal of Pharmacy and Technology. 2020;13(12):5987-92. https://doi.org/10.5958/0974-360X.2020.01044.6
40. Nepal A, Jana S, Bhutia S. Review on medicinal plants of Sikkim Himalayan region with emphasis on anticancer study. Journal of Applied Pharmaceutical Science. 2024;14(2):013-26. https://doi.org/10.7324/JAPS.2024.162372