CURRENT STUDIES TO JUSTIFY THE MEDICINAL POTENTIAL OF THE ORCHID DENDROBIUM MACRAEI LINDL

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Abstract

Orchids are often admired for their aesthetic appeal, but they also have medicinal value. Orchids are highly prized for their medicinal properties due to the discovery of numerous phytochemicals, including alkaloids, flavonoids, and glycosides. *Dendrobium macraei* is an important orchid in Ayurveda since it is thought to be where Jivanti originates. The plant can be used as an expectorant, aphrodisiac, tonic, and in cases of heat exhaustion as it has a cooling effect. Asthma, bronchitis, "tridosha," throat issues, fevers, burning sensations, biliousness and disorders of the eye and blood are all treatable thanks to its medicinal characteristics. Extensive research was done on a variety of articles from different databases, and during this time, a number of articles and manuscripts were also deleted due to the lack of data on the species of *Dendrobium macraei* that was required for the construction of this document. Not only orchids are prized as ornaments, but they are also employed in herbal medicine. Seldom are the species utilised for various types of activity. To extract and identify the active compounds, as well as the mechanisms and modes of action that would serve as a source of communal knowledge on this plant from future perspectives, more research is required to examine the traditional usage of this plant scientifically**.** *Dendrobium macraei* contains phenolic compounds and flavonoids, it seems to be a potential candidate for enhancing memory, as a potent anti-inflammator and acts as a free radical scavenger. However, more research is required to fully explore the potential of *Dendrobium macraei* in treating a variety of ailments based on data from the literature study and traditional applications.

Keywords: Dendrobium Macraei, Orchids, Phenolic Compounds, Traditional Uses.

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1. Introduction

According to WHO, a significant portion of the global population relies on herbal medicines for their basic medical needs Throughout the beginning of time, many conventional medicines have been used to treat illnesses, such as Aspirin (which is made from willow bark), digoxin (which is made from foxglove), quinine (which is made from cinchona bark), and morphine (which is made from the opium poppy) [(1).] Asthma, ulcerative colitis, rheumatoid arthritis, Crohn's disease, tendonitis, and many more disorders are brought on by inflammation. Additionally, certain diseases including obesity, diabetes, atherosclerosis, cancer, and CNS disorders might emerge if the inflammation reaches a particular threshold of advancement. When inflammation is under control, it is crucial for preventing the body from degrading in a way that could be harmful, but if inflammation is destructive, the body will undergo undesirable disintegration.
In the Charka Samhita, herbal remedies are recommended for the prevention and treatment of specific types of inflammatory disorders, and they do indeed serve as a very beneficial source of key chemical components that help to lessen the symptoms of inflammatory diseases [(2).]

One of the world's oldest civilizations, India is known for having an abundance of medicinal plants. A broad variety of aromatic and medicinal plants, which are mostly picked for use as raw materials in the creation of medicines and other items, are primarily found in India's woods.

There are around 8,000 herbal remedies in the database of AYUSH systems [(3).]

Theophrastus first used the term "orchid" to describe how the architecture of the plants resembles testicles. The Greek word for orchid directly translates to "testicles." This could explain why orchids were once used as aphrodisiacs. Ayurveda and Traditional Chinese Medicine (TCM) are at the forefront of the history of ancient alternative medical systems [(4,5)]. With an estimated 20,000 to 35,000 species worldwide, the orchid family is one of the largest, most diverse, and distinctive families in the flowering plant kingdom [(6).] With 1184 species, Dendrobium is the second-largest genus in the Orchidaceae family [(7)].

The decorative significance of orchids is well known, but they are also utilised in herbal medicine [(8)]. Orchids have been used medicinally for a very long time, and the Chinese were the first to use them as herbal remedies [(9)]). They demonstrated that the bulk of the phytochemicals, including alkaloids, flavonoids, and glycosides, that have made orchids valuable as medicines were present [(10).]

India has conducted chemical tests on a number of orchids that are useful in the treatment of disease. Eulophia campestris, Orchis latifolia, and Vanda roxburgii are a few interesting plants [(11).] Dendrobium macraei is a vital orchid from an Ayurveda perspective as it is thought to be the source of Jivanti. It is an epiphyte with a creeping rhizome and a pendulous stem [(12)]. The herb is cooling, alterative, astringent to the bowels, tonic, aphrodisiac, and expectorant. It also has a sweet flavour. Because to these qualities, it can be used to cure illnesses including asthma, bronchitis, "tridosha," throat issues, fevers, burning sensations, biliousness, and blood and eye ailments. Plants are tonic and energising. The dried complete plant of *Dendrobium macra*ei is shown in Fig.1. and Fig. 2 depicts the flower of *Dendrobium macraei*.

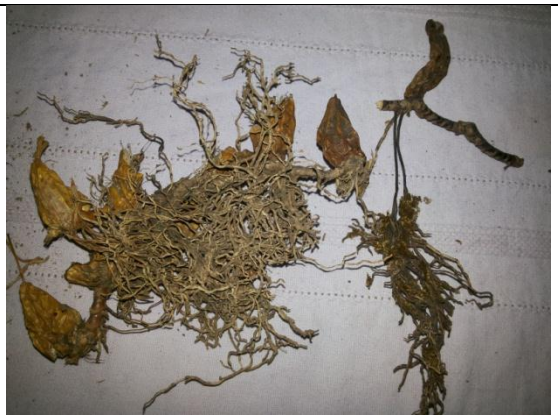

Fig 1 (Dried whole plant of *D. macraei*)

Fig 2 (Flower of *D. macraei*)

2. Literature Review

Investigating multiple electronic scientific book databases, such as Google Scholar (2), Science Direct (2), Pub Med (7), and Research Gate, yielded a literature review for this review (8). Open-source articles in the public domain provided the pertinent data. The information was searched using key words like "*Dendobrium macraei*," "Orchids," "Sag," "Jiban," and "Jivanti." Numerous articles from the aforementioned databases were thoroughly examined, and during the reviewing process, several articles were also excluded due to the lack of information about the Dendrobium species that was needed for the creation of this manuscript. The numbers listed after each database name support the inclusion of that database's number of articles in the current manuscript.

3. Results

About 400 articles were generally obtained as a result of the investigation. The convenience of around 40 articles, including both clinical and non-clinical studies, led to their inclusion in this review article. It includes the study of nomenclature, synonyms, geographical distribution, taxonomical profile, therapeutic significance, production, chemical constituents, ethanopharmacology and phytochemistry studies which are emphasized as follows:

3.1. Nomenclature

In Nova Acta Regiae Societatis Scientiarum Upsaliensis, published in 1799, Olof Swartz formally established and described the genus Dendrobium. Since most Dendrobium species are epiphytes, the name comes from the Greek words for "tree," dendron, and "life," bios(13). In 1830, Lindl. identified Dendrobium macraei, a species of orchid. Thelychiton, Tropilis, Vappodes, and Winika are a few of the smaller genera that David Jones and Mark Clements divided the genus Dockrillia into in 2002. Nevertheless, the World Checklist of Selected Plant Families considers each of these genera to be synonyms. Friedrich Brieger's classification of the terete-leaved dendrobiums from Australia and New Guinea (14, 15) included all of them.

3.2. Synonyms[36]

- *Flickingeria macraei* (Lindl.)
- *Flickingeria fimbriata*
- *Ephemerantha macraei* (Lindl.)
- *Callista macraei* (Lindl.)
- *Dendrobium nodosum* (Dalz.)
- *Flickingeria rabanii* (Lindl.)
- *Desmotrichum fimbriatum*
- *Dendrobium fimbriatum* (Bl.)
- *Flickingeria nodosa* (Dalz.)

3.3. Geographical Distribution

Aerophyte *Dendrobium macraei* has a gloomy rhizome and a nodded stem. This orchid is indigenous to the Khasia Hills, which are located at an elevation of 4000 feet, and the Sikkim Himalayas, which are situated at an altitude of between 700 to 8000 feet. The Nilgiri Hills, Dalzelli, Konkan, Sri Lanka, Ram Ghat, and Java are all home to this orchid. Typically, it comes from Goa, Karnataka, Kerala, Maharashtra, and Tamil Nadu in India [(16).]

3.4. Taxonomical Profile

Aerophyte Dendrobium macraei has a sinister rhizome and a nodded stem. This orchid is a species of orchid that is indigenous to the Khasia Hills, which are located at a height of 4,000 feet, and the Sikkim Himalaya, where it may be found between 700 and 8000 feet above sea level. This orchid can be found in the Nilgiri Hills, Dalzelli, Konkan, Sri Lanka, Ram Ghat, and Java, among other areas. It often first appears in India in Goa, Karnataka, Kerala, Maharashtra, and Tamil Nadu (16).

Having a single, apical, erect, linear-oblong to lanceolate, obtuse, many nerved, sessile, dark green leaf, this medium-sized, warm-to-cold-growing epiphyte has semi-upright and pendulous branches that develop into fusiform, comparatively flat, green, and shiny pseudobulbs. It blooms all through the summer and the first few weeks of the fall on a short, single flowering inflorescence with broadly oval leaves (18).

Branches are Pseudobulbs have solitary, sessile, 10 to 12 cm long leaves. The roots are between 0.2 and 0.4 cm in diameter and have a thinner tegmentum layer covering them. The branches end in a pseudobulb that is between 5 and 6 cm long and have a hue that mimics golden yellow. Pseudobulbs finally form on slender, annulate, first greenish stems that later turn yellow, are incredibly smooth, and are densely branching stems.

Additionally, the pseudobulbs are compressed, wrinkled, and pale yellow in color, with an oblong or fusiform shape. They are 3.5 by 1.5 cm in size. One to three white, one-centimeter-long flowers, which sprout from the base of the leaf, are present.

There are no distinguishing flavors or odors associated with this plant (19).

3.5. Therapeutic Significance

Dendrobium is one of a very large group of orchid genera that make up the Orchidaceae family. Many species in this genus have been found to have beneficial medicinal properties, including antioxidant, antitumor, and anticancer properties[(20)]. Further anti-platelet aggregation, anti-fibrotic, free radical scavenging, immunomodulatory, and cytotoxic properties are shared by Dendrobium species[(21,22,23)]. The medicinally significant dendrobium species possess a number of unique properties as well, including tonic, the ability to resist sickness, and antidepressant. Since ancient times, the Dendrobium genus has been used as a traditional medicine to treat a variety of ailments, including emaciation, bowel disorders, impotence, asthma, bronchitis, general discomfort and inflammation, and tuberculosis [(24).] One of the Dendrobium species, specifically the roots of *Dendrobium macraei* constitutes flavonoids, alkaloids, carbohydrates, coumarins, phytosterols, and phenolic chemicals[(25,26)]. The aforementioned chemical ingredients, which have been reported to possess antidepressant, anti-inflammatory, antibacterial, and also employed for the management of diabetes and as free radical scavenger and are prominently highlighted in the manuscript [(27,28).] The entire plant of *Dendrobium macraei* is reported to offer memory-improving qualities, anti- inflammatory potential and radical scavenging

properties. Traditionally the entire plant is reportedly aphrodisiac, tonic, styptic for bowels, expectorant, soothing, medicinal, "tridosha," soothing for throat discomfort, and general fevers. The drug is very effective in treating bronchitis, asthma, light sensitivity, eye, and blood conditions. The entire plant is said to have hepatoprotective and aphrodisiac qualities. Plant is recognised as a stimulant and general tonic. Tubers reportedly offer a wide-ranging tonic and invigorating effect. The fruit's decoction is used for general regeneration and long life, as well as to treat chest congestion and coughing. Dendrobium plant fruits are used in the production of Ayurveda medications [(40).]

3.6. Production

The plant is an epiphyte with a creeping rhizome and pendulous stem, can be found in the Konkan, Ram Ghat, Dalzelli, Nilgiri Hills, Sri Lanka, Java, and the Sikkim Himalayan at an altitude of 7000–8000 feet [(29).]

3.7. Chemical Constituents

Dendrobium macraei is considered an essential orchid in Ayurvedic medicine since it is said to be a major source of Jivanti. The presence of alkaloids, flavonoids, carbohydrates, phytosterols, coumarins, and different phenol-containing substances was discovered in the pharmacognostic and phytochemical research of *Dendrobium macraei* methanolic extract of roots. The knowledge is useful in determining the quality and efficacy of *Dendrobium macraei* roots. Jibantine, a resinous substance including diosgenin derivatives such as defuscin and denfigenin, as well as jibantic acid, was claimed to be the main chemical constituent of *Dendrobium macraei*. Many research on the *Dendrobium macraei* plant revealed a significant concentration of phenols and flavonoids in methanolic and ethyl acetate extracts of the complete plant [(30,31,32).]

Jivanti is a major Rasayana medicine according to Ayurveda and is utilised as an ingredient in formulations such as jivantadya ghrita, jivantayadi rasa, jivantadyadi taila, Ashwagandhadi ghrita, anuthaila, chandanadithaila, which are used in the treatment of tuberculosis, emaciation, fever [(33,34,35).]

3.8. Review of Ethanopharmacology

The entire plant of *Dendrobium macraei* is reported to have memory-enhancing qualities. It also possesses the anti inflammatory potential[(27)]. The entire plant has a beautiful taste, is relaxing, therapeutic, styptic for bowels, "tridosha," throat discomfort, general fevers, tonic, aphrodisiac, and expectorant, according to reports. The medication is quite beneficial in the treatment of blood and eye diseases, as well as bronchitis, asthma, and light sensitivity. The entire plant, according to accounts, possesses hepatoprotective and aphrodisiac effects. The plant is thought to be a general tonic and stimulant [(14).] Tubers, according to studies, have a broad tonic and stimulating impact. The decoction of the fruit is used to treat chest congestion, coughing, and for general regeneration and longevity. The fruits of the dendrobium shrub are used to make Ayurvedic remedies. The fruits of *Dendrobium macraei* also have aphrodisiac effects. The *Dendrobium macraei* root paste is used to treat dermatitis, many skin allergies, and snake bites, as well as to balance vata, pitta, and kapha. The pseudobulbs are also said to have free radical scavenging capabilities [(40).]

3.9. Review of Phytochemistry

Dendrobium macraei is regarded as an important orchid in Ayurveda because it is thought to be the principal source of Jivanti. Pharmacognostic and phytochemical investigations of *Dendrobium macraei* methanolic extract of roots revealed the presence of alkaloids, flavonoids, carbohydrates, phytosterols,

coumarins, and other phenol-containing compounds. This knowledge aids in determining the efficacy and purity of *Dendrobium macraei* roots. According to sources, the major chemical component of *Dendrobium macraei* is jibantine, a resinous molecule containing the diosgenin derivatives defuscin and denfigenin, as well as jibantic acid. Several studies on the *Dendrobium macraei* plant found that the entire plant's methanolic and ethyl acetate extract had significant amounts of phenols and flavonoids [31].

Table 1: Reported activities on *Dendrobium macraei*

S.No.	Pharmacological investigation	Results	References
1.	**Memory enhancing activity (**Memory Enhancing Activity of *Dendrobium macraei* Lindl. in Swiss Albino Mice**)**	Methanol and ethyl acetate extract of *Dendrobium macraei* exhibited noteworthy long term and short-term memory enhancing activity when performed on elevated plus maze and Morris's water maze model in mice. Ethyl acetate extract (200 mg/kg, p.o.) showed remarkable (P<0.05) effect in comparison to methanol extract (200 mg/kg, p.o.) in both the models. So, it would be worth to investigate the potential of this plant in the management of dementia.	Bora & Vatsa; 2016, (37)
2.	**Free radical scavenging activity**		
a)	Phytochemical Evaluation and *in vitro* Free Radical Scavenging Activity of Cold and Hot Successive Pseudobulb Extracts of Medicinally Important Orchid *Flickingeria nodosa* (Dalz.) Seidenf.	The result revealed that the highest DPPH scavenging and ABTS scavenging activity was seen in the cold acetone extract, hydroxyl radical scavenging activity was more with hot chloroform extract and nitric oxide scavenging activity was more with cold water extracts. The plant can be a source material to herbal drug industry since it is a reservoir of phytochemical components that can be used for the development of therapeutic phytomedicine for the therapy and treatments.	Nagananda *et al*., 2013 (38)
b)	Phytochemical Investigation and Evaluation of in-vitro Free Radical Scavenging Activity of *Flickingeria nodosa* Lindl.	The present research reveals the free radical Scavenging Activity of the extracts of *Flickingeria nodosa* Lindl. This is due to existence of phytoconstituents like phenolic compounds and flavonoids.	Chhajed *et al*., 2008 (39)

3.	Studies on anti-inflammatory activities of whole plant of *Dendrobium macraei* Lindl.	The present study revealed the anti-inflammatory activities in *Dendrobium macraei* whole plant extracts. The carrageenan induced rat paw oedema model was used for the evaluation of the anti-inflammatory activity of hydromethanolic extracts. At doses 100, 200 & 400 mg/kg *D. macraei* exhibited significant and dose-dependent effects of anti-inflammatory activity. The extracts exhibited a dose-dependent reduction in paw oedema volume at different doses of 100, 200 and 400 mg/kg. The methanolic hydro extract at doses 100, 200 and 400 mg/kg significantly inhibited carrageenan-induced paw oedema volume at 1h, 2h and most significantly at 3h as compared to the control. The standard drug indomethacin shows marked and significant inhibition in the volume of paw oedema at 3hr at 5 mg/kg dose through the oral route of drug administration.	Vatsa *et al*., 2023 (27)

4. Conclusion

Despite a lengthy history of usage as a traditional medicine for a variety of diseases, particularly in CNS problems as a nervine tonic and stimulant, *Dendrobium macraei* has never been exposed to CNS activity tests. As a result, it was thought worthwhile to test *D. macraei* for memory boosting activity as well as several pharmacognostic standardisation tests.

Dendrobium macraei appears to be a viable option for memory enhancement, and it would be useful to investigate its potential in the treatment of Alzheimer's patients. It has also been discovered to be effective as a free radical scavenger due to the presence of phytoconstituents such as phenolic compounds and flavonoids. It has also shown the promising effect as anti-infalammatory drug due to the presence of flavonoids and phenolic compounds in abundance. Yet, more research is required to investigate the full potential of *D. macraei* in various disorders based on findings from the literature survey. This orchid is medicinally quite potent, and it is worth further research in the future.

Conflict of Interest

All authors declare no conflict of interest.

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5. References

1. WHO, Progress Report by the Director General, Document No. A44/20, World Health Organization, Geneva, 1991.

2. Stuart GA, Chinese Materia Medica, Taipei, Southern materials centre, 1984.
3. Bhat ZA. Traditional medicines in drug discovery. *J Pharm Res*. 2015; (5):2457-9.
4. Stewart, J. and Griffiths, M., 1995. Manual of orchids, Timber press, Portland, Oregon.
5. Hossain MM. Therapeutic orchids: Traditional uses and recent advances—an overview. Fitoterapia 2011;82 (2):102–140. DOI: 10.1016/j.fitote.2010.09.007.
6. Dressler, R.C., 1993. Phylogeny and classification of the orchid family Dioscorides, Portland.
7. Leitch, I.J., Kahandawala, I., Suda, J., Hanson, L., Ingrowille, M.J., Chase, M.W. and Fay, M.F., 2009. Genome size diversity in orchids: Consequences and evolution, *Annals of Botany*, Issue 104, pp: 469-481.
8. Sumner, J., 2000. The natural history of medicinal plants, Timber Press, Oregon, USA.
9. Bulpitt, C.J., 2005.The uses and misuses of orchids in medicine QJM: An *Intern.Journal.Medicine*, Issue 98, pp: 625-631.
10. Pengelly, A., 2004. The constituents of medicinal plants: An introduction to the chemistry and therapeutics of herbal medicine, sunflowers and herbals, Issue 2, pp: 184.
11. Uniyal, M.R. and Uniyal, M., 1977. Medicinal plants and minerals of Uttarakhand Himalaya, Baidyanath, Ayurveda Shodhsanstha,Patna.
12. Kasera, P.K. and Shukla, J.K., 2001. Bio medicinal properties and cultivation of *Leptadenia reticulata (Jivanti)- an endangered plant of the India*, *Curr.Sci.Thar Desert*, Issue 7, pp: 877.
13. Santapau, H. and Kapadia, Z., 1966. The Orchids of Bombay, Govt. of India, The Manager of Publication, Civil Lines, New Delhi, pp: 680-682.
14. Kirtikar, K. R. and Basu, B.D., 1989. Indian Medicinal Plants, Published by Lalit Mohan Basu, Allahabad, Vol.4, Issue 2, pp: 2401-2402.
15. Singh, B., Saxena, A.K., Chandan, B.K., Agarwal, S.G. and Anand, K.K., 2001. In vivo hepatoprotective activity of active fraction from ethanolic extract of *Ecliptaalba*leaves.*Indian J. Physiol. Pharmacol.*, Vol. 45, pp: 435–441.
16. Gamble, J.S., 1957. Flora of the Presidency of Madras, CEC Fischer, Botanical Survey of India, Calcutta, Vol.3, pp: 597-598.
17. Santapau, H. and Kapadia, Z., 1966. The Orchids of Bombay, Govt. of India, The Manager of Publication, Civil Lines, New Delhi, pp: 680-682.
18. Madhavan, V., Tomar, G.S., Yoganarasimhan, S.N. and Gurudeva, M.R., Pharmacognostical studies on *Flickingeria nodosa* stem and pseudobulbs – A botanical source of the Ayurvedic drug Jivanti, *Indian Journal of Natural products and Resources*, Vol.1, (1), 2010, pp-22-28.
19. Lüning B, Alkaloid content of Orchidaceae. In: Withner CL, editor. The orchids: scientific studies. New York: John Wiley and Sons, 1974.
20. Balsubramanian P, Rajesekaran A & Prasad SN, Notes on distribution and ethnobotany of some medicinal orchids in Nilgiri biosphere Reserve. *Zoo's Print Journal*., 2000; 15 (11) pp- 368.
21. Rao AN, Medicinal orchid wealth of Arunachal Pradesh. Newsletter of Envis node on Indian Medicinal plants, 2004; 1 (2), pp-1-5.
22. Wealth of India, Raw Materials, D-E, CSIR, New Delhi, 1952; 3, pp- 43-44.
23. Lavarack B, Harries W, & Stocker G, Dendrobium and its Relatives. Timber Press, Portland, 2000.

24. K. Pagag, S.K. Singh* & D.K. Roy, Notes on blooming of a rare orchid *Flickingeria macraei*, *Keanean Journal of Science*, Vol 4 2015 35-38.
25. Vatsa E, Chandel S, Parashar B &Neeru*et al.* Physico -Chemical and Phytochemical Evaluation of *Dendrobium macraei* Lindl. (Whole Plant), *International Journal of Pharmacognosy and Phytochemical Research*. 2016; 8(11): 1801-1811.
26. Wood H, The Dendrobiums, A.R.G, GanterVerlag Publishers, 2006.
27. Vatsa E, Faujdar S, Chandel S , Chaudhary N , Kumar A, Neeru, Studies on anti-inflammatory activities of whole plant of Dendrobium macraei Lindl.,*Eur. Chem. Bull*., 2023; 12(Special Issue 1), pp- 657-664.
28. Lo SF, Mulabagal V, Chen CL, Kuo CL &Tsay HS *et al.* Bioguided fractionation and isolation of free radical scavenging component from in vitro propagated Chinese medicinal plants *Dendrobium tosaense* Makino and *Dendrobium moniliforme.* 2004; 52: 6916–6919.
29. Chattopadhyay P, Banerjee N & Chaudhary B, Genetic Characterization of Selected Medicinal *Dendrobium*(Orchidaceae) Species Using Molecular Markers, *Research Journal of Biology*, 2012; 2 (4),pp- 117 -125.
30. The Ayurvedic Pharmacopoeia of India. Government of India, Ministry of Health and Family Welfare, AYUSH, New Delhi, Part-II, 2008, Vol.2, Issue 1, pp: 263, 167.
31. Prajapati, C.N. and Patel, N.M., 2013. Physico-Chemical and Phytochemical Evaluation of *Dendrobium macraei* Roots. *International Journal of Research in Pharmaceutical and Biomedical Sciences*, Vol. 4, Issue 1, pp: 75-80.
32. Saroya, A.S., 2010. Herbalism, phytochemistry and ethnophamacology, Published by science publishers, pp: 305.
33. Wealth of India, 1952. Raw Materials, D-E, CSIR, New Delhi, Vol. 3, pp: 43-44
34. Sharma, P.C., Yelne, M.B. and Dennis, T.J., 2001. Database on Medicinal Plants used in Ayurveda, CCRAS, Dept. of ISHM & H. Ministry of H & FW. Govt. of India, New Delhi, Vol.2, pp: 270-276.
35. Yoganarasimhan, S.N., 2000. Medicinal plants of India-Tamilnadu, Vol.2, pp: 519.
36. Chopra, R.N., 1958. Indigenous Drugs of India, U. N. Dhar& Sons Pvt. Ltd., Calcutta, Issue 2, pp: 512.
37. Vatsa E & Bora KS,Memory Enhancing Activity of *Dendrobium macraei*Lindl. in Swiss Albino Mice, *British Journal of Pharmaceutical Research*, 2016; 13(2), pp- 1-11.
38. Nagananda GS, Satishchandra N and Rajath S, Phytochemical Evaluation and *in vitro* Free Radical Scavenging Activity of Cold and Hot Successive Pseudobulb Extracts of Medicinally Important Orchid *Flickingeria nodosa* (Dalz.) Seidenf. *Journal of Medical Sciences*, 2013;13 , pp- 401-409.
39. Chhajed MR, Tomar GS, Gautam SP, Hariharan AG, Phytochemical Investigation and Evaluation of in-vitro Free Radical Scavenging Activity of *Flickingeria nodosa* Lindl., *Indian J. Pharm. Educ. Res*., 2008; 42(4).
40. Kaushik P, Anatomical and ecological marvels of the Himalayan orchids. New Delhi, India: Today and Tomorrow's Printers and Publishers; 1983.