Advances in Bioresearch
Adv. Biores., Vol 15 (6) November 2024: 254-260

Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.15.6.254260

Advances in Bioresearch

REVIEW ARTICLE

Urginea Indica: An Overview of Phytochemistry and Pharmacological Properties

Vasant Yashwant Chavan1*, Ashish Vilas Kulkarni1, Avinash Ashruba Gunjal1, Prasad Kailas Bairagi1
1Department of Pharmacology, Dr. D. Y. Patil College of Pharmacy, Akurdi, Pune, Maharashtra, India.
***Corresponding Author:** Mr. Vasant Yashwant chavan
Email: vasantchavan392@gmail.com

ABSTRACT
Urginea indica (Roxb.), Drimia indica. Reputable ayurvedic herb jessop (Asparagaceae) is applied to several categories of diseases, such as a skin conditions, rheumatism, asthma, dropsy, heart disorders and dyspepsia. The objective of this study was to conduct a thorough and critical examination of Urginea indica, covering its traditional applications, phytochemical composition, pharmacological effects, toxicity, taxonomy, and the mechanisms of action associated with specific extracts. A thorough review of the notes was done using a textbooks and traditional texts in addition to scientific sources including Web of Science, Scopus, and PubMed. The plant is mainly used as a bulb includes such as phytosterols, bufadienolides , alkylresorcinols . The plant's extract includes anti-microbial, wound-healing, anthelmintic, cancer prevention, and diabetic medications qualities as demonstrated by numerous scientific investigations. The current study comes to the conclusion that Urginea indica could potentially be used to treat a number of illnesses.
Keywords: *Urginea indica, Classification, Phytochemicals, Characteristics, Pharmacological Activities.*

Received 24.05.2024 Revised 01.10.2024 Accepted 23.11.2024

How to cite this article:
Vasant Yashwant C, Ashish Vilas K, Avinash A G, Prasad Kailas B. *Urginea Indica*: An Overview of Phytochemistry and Pharmacological Properties. Adv. Biores., Vol 15 (6) November 2024: 254-260.

INTRODUCTION

Urginea indica is a common name for the Indian squill, real squill, and sea onion. The plant also known as jungli piyaz or ban piaz in Asian nations. [1] *Urginea indica*, primarily the bulb, is an ayurvedic herb commonly referred to as Kolkanda or Ban Palandu. It is used as a biocide and to prepare a variety of therapeutic preparations with healthcare applications. [2] Studies on the plant's phytochemistry have shown that steroids are exclusively found in the bulbs, and alkaloids, carbohydrates, proteins, flavonoids, phenols, and tannins are abundant throughout the plant. Glycosides, quinones, resins, and saponins are also present in the bulbs. In Ayurveda, the herb is used to treat intestinal worms, skin conditions, dysmenorrhea, and respiratory issues. In several studies, the plant has shown strong antidiabetic, antioxidant, anthelmintic, analgesic, spasmodicl, and cardiac. [3] Out of 99 recognized species, 9 species *Drimia*— Asparagaceae family in India. [4] These plants can be found throughout Asia and Africa. The majority within that family species they are present in semiarid areas of Africa's south-east that receive winter rainfall. [5, 6] *Urginea*, commonly known as Indian squill, is utilized both in pharmaceuticals and agriculture. The ancient Egyptians were the first to uncover its effectiveness in treating edema, emesis, and coughs. Even in modern medicine, it remains relevant as an expectorant, often included in various commercial cold remedies. The extract of bulbs, known as a cardiotonic in ancient Roman times, is still under research today. The recreational consumption of the digitalis plant carbohydrate squill as cardioactive drugs is prohibited in the United States of America due to its growing popularity regardless of the German Commission's 1985, authorization for cardiovascular impairment. For more than a century, many squill species have been used successfully as rodenticides (Table 1). [7] *Urginea* species, particularly are extremely variable, falling into two separate species. The initial classification is quite unusual is that it consists of subterranean bulbs that produce the flowering process devoid of branches

that grow right following the initial rainstorm and endure a harsh. Afterwards initial on a rainy season raindrop, flowers appeared on direction. [8]

PLANT DESCRIPTION

The herb *Urginea indica possesses* that originate its bulb, which is pear-shaped and conical. These roots typically measure around 6 to 10 inches in length (Fig. 1). The bulbs extract has visible external scalars, about comparable to that of a large bulb. Including fresh shades of brownish and papery red in color absolutely encompassing each other, engrossed in the smooth edged, fourth-leaflets grow from the bulbs as an a rosette, regarding 2-3 centimeters in diameter and 15 to 30 centimeters in length. The months of April and May see flowering plants are grown. A long, rigid, smooth succulent flower riser center branches they are measuring about 3 feet in height had near spikes of white blooms that appear on a purple stem. (Table 2). [9] The *Urginea indica* medicinal plant was chosen due to its ethnomedical significance as a natural remedy and its historical use in treating various illnesses by the tribal people of Chhattisgarh's Bastar area. The plants extract is *Urginea indica* that was not affected by disease and in good health were chosen to evaluate the antibacterial activity, anti-inflammatory, antidiabetic, antioxidant. [10]

Fig. 1. *Urginea indica*

Table 1. Taxonomical Classification:

Botanical Name	*Urginea indica*
Common name	Jungli Pyaz, Van panndu, kolkanda
Classification	Kingdom: Plantae Subkingdom: Tracheobionta Division: Magnoliophyta Class: Magnoliopsida Subclass: Liliidae Order: Liliales Family: Liliaceae Genus: *Urginia* Species: *Indica*
Apply of Different Parts	Root, Steam and Bulb.
Pharmacological Elements	The bulb: deobstruent, emmenagogue, cancer-fighting, antiarthritic, cardiac, heart stimulant, antidiabetic, and alexiteric anticipation. The Plant: a stimulant and cyanogenetic.
Medicinal use	1. This herb improves the metabolism of products of elimination and aids in opening the human body's innate valves. It also improves the removal of catarrhal waste. 2. It clears the body of mucus in cases of chronic bronchitis, asthma, and pulmonary vomiting. The herb's juice is consumed with syrup. 3. It regulates erratic menstruation. 4. 4) The bulb has been used to treat diarrhea

Table 2. Morphology:

Habit	Herb. Plans; a cluster of leaves.
Root	Stringy, golden, dense
Root Length	3 cms.
Height of Plant	11.2 cms-15 cms.
Circumference of the bulb	12 cms.
Fruit length	1.3 cms
Fruit circumference	0.9 cms

PLANT MORPHOLOGY:

1. Bulb Morphology:

The perennial geophyte *Urginea indica* commonly referred to as Indian Squill, contains fibrous roots that range in length from six to ten inches. A scapigerous herb grows from the base of the bulb, its conical in shape. The size of a large onion, shaped like pears bulbs have translucent white outer scales, composed of thin, and papery, reddish-brown or orange-brown spongy coatings that fully envelop each other. (Fig. 2). [11, 12]

Fig. 2. Bulb of *Urginea indica.*

Maceration of Bulbs:

The component should be extremely little particles place the substance in test tube and cover with just the right amount of nitric acid to dissolve it, then after that, add some of the potassium chlorate crystal. Gently temperature of the material Through the explodes appear, then allow the solution of reagent to work for approximately four to five minutes, or until the substance becomes white.

After a water is used for properly washing the substance being cleaned it may be placed and prodded with syringes. Alternately, it could be shaken in a bottle of water until a large number of the cells separate. Following full immersions in the water, the content can get discoloured. That enormous tracheid, which were detached with this manner stained slightly discolored with the substance safranin, showed slightly angular suberized root architecture spider am cells. The bark is located made up of cells that are located *OUTSIDE* THE EPIDERMIS three layers from the exodermis or the epidermis. Eight rows of big round cells of the parenchyma with glandular fluids surround this on the inside. The skin layers consists of only a single layer of cell along with casperian thickenings and extremely thin walls. Pericycles have two separate layers. The stele is smaller compared. The cells of the branches of the primitive Stagnation range in number from 5 to 15 and are radial in different communities. [13-15]

2. Leaf Morphology:

Equifacial leaves are present, the protective layer of cuticle that lies below the upper and lower epidermis covers the partially higher and lowers epithelium. The eight to eleven flexible parenchyma placed across the two barriers is made up of roughly oval cells, some of which have crystals resembling raphide. In spongy parenchyma, the bundles of vessels are organized in only one line. The circulatory tract does not exist significantly higher than the others. Thus, the midrib not make up a projected portion. The stomata that grow on the amphistomatic leaves are of the anomocytic variety. The cells of the epidermis and stomata are situated at the exact same level. Specifically, there are metamorphic type stomata on them; perigynous (no subsidiary). The gelatinous substance cells are found in the mesophyll; these cells usually consist of crystal. [16-18]

3. Root Morphology:

The root of the plant has an overall diameter of 1.8 mm and an oval shape. It is made up of a broad, uniform parenchymatous cortical and a fragmented epidermal. A stele has been placed in its center and his diameter is 300 nm. There is an endodermoid layers inside that is epithelium. Its eight circulars in shape wide metaxylem components cover the whole center region of the state's surface. Its eight circulars in shape wide metaxylem components cover the whole center region of the state's surface. At the outermost layer of every metaxylem elements, a protoxylem element arises. The xylem strands exhibit an exarch arrangement, while the phloem displays a radical configuration. The diameter of the metaxylem elements measures 50 μm. [19]

PHYTOCHEMICALS:

Steroid glycosides are *Urginea indica's* main active compounds. The bulb of *Urginea indica* contains among various steroidal glycosides present. [20] Numerous potentially bioactive phytochemicals were extracted from the bulb. The herb also contains antifungal glycoproteins, steroids, sugars, flavonoids, and saponins (Table 3). [21, 22] *Urgenia indica* has been noted for its antifungal properties as well.[23, 24]

Table 3. Compounds found within *Urginea indica* and their respective activities:

Sr.no	Compound	Activity
1	Dextrose	Antihepatatoxic, Antiketonic, hypereglycemic.
2	Scillaren	Antirhionoviral, cardio tonic, insecticides
3	D-mannose	Anti-cystic
4	Quercetin	Cancer-preventive
5	Flavones	Inflammation-reducing
6	Scillarenin	Antiviral
7	Scilliglaucoside	Cardiac
8	Xylose	Diagnostic
9	Mucilage	Demulcent

PHARMACOLOGICAL ACTIVITY

1. Antidiabetic activity:

One of the biggest global health issues is diabetes mellitus, a metabolic disease with several etiologies characterized by a failure of glucose homeostasis and disruptions in the metabolism of fat, protein, and carbohydrates as a result of abnormalities in insulin secretion and action diet, exercise, and contemporary medications (insulin) can all be control diabetes. Several models are being used in antidiabetic activities. Diabetes is induced by alloxan and streptozotocin.

Biochemical parameters to be tested:

1. Touch was used to measure blood glucose
2. The amounts of high-density lipoprotein HDL, overall cholesterol (OC), and triglyceride (TG).

Antidiabetic Activity given that *Urginea indica* is traditionally used to treat diabetes, an antidiabetic investigation was done on the bulb's extract of ethanol towards rats that were given streptozotocin to produce diabetes (Table 4). Both the usual medication, glibenclamide (10 mg/kg). Within 120 minutes, it was discovered that the extract.

The extract total cholesterol in addition to lowering blood sugar. In addition, it was discovered that the high-density lipoprotein levels had improved in comparison to the rats in the untreated group. According to the histological analysis, the extract helped the rats' pancreatic islets' injured cellular population partially recover. The study's effective 1.5 g/kg of dosage was too high to be employed in a clinical setting purified plant bioactives or fractions guided by bioassays ought to be investigated with diabetes. Furthermore, since the of the activity had been applied against the crude extract it cannot be regarded as good in comparison to glibenclamide. The main scientific investigation on the plant's antidiabetic properties that is currently available, and more research employing various methodologies ought to be done as well. For the activity, the extract's bioassay-guided fractions or *Urginea indica's* isolated components should be utilized. [25]

2. Anticancer Activity:

Millions of deaths worldwide are caused by cancer, a serious global health issue. It is to blame for about 7.6 million deaths globally, with an anticipated rise to 13.1 million by 2030. Even with the advancements in cancer research, the quest for and development of anti-cancer therapeutic agents remains necessary. [26]

Models based on anticancer activity are used.

1. Xenograft Model of Tumor.
2. A mouse with genetic engineering.

3. Anti-inflammatory Activity:

These days, there is a lot of interest in researching the development of natural origin medications for alleviating pain and inflammation because, of the major side effects, which include respiratory, kidney, and gastrointestinal issues. recently accessible within nonsteroidal anti-inflammatory drugs and opioids. While *Urginea* utilized in across Asian countries alleviating inflammation and internal pain, scientific substantiation of its efficacy remains lacking.

According to in study, the material dried in an oven.
Infectious microorganisms including bacteria, viruses, and fungi typically cause inflammation when they enter the body, settle in a specific tissue, and move through the bloodstream. Inflammation can also result from processes like degeneration, ischemia, malignancy, tissue damage, and cell death. [27]

4. Wound Healing Activity:

The definition of a wound is the disruption of the cellular, anatomical, and functional integrity of living tissue. It can outcome from a tissue injury microbiological means interplay between a complex cascade of cellular and biochemical action maintaining is what causes wound healing. Various models are employed in wound healing activities.

1. Burn injuries.
2. Impaired wound model: obesity, diabetes, and marasmus.

An assessment was conducted on the wound healing potential of a dichloromethane extract *Urginea indica* with a skin wound measuring 2 centimeters in length and 2 millimeters in depth. Topical administration of the extract at a enhanced remodeling injured area.
Additionally, was also poorly understood, to precisely identify the bioactive component and mode of action of the active extract/fraction, more study is necessary in this regard. [28]

5. Analgesic Activity:

As a distressing sensory and emotional experience associated with the possibility of actual tissue damage, is known as analgesic activity. Certain techniques are employed in the analgesic activities. They are as follows [29] .

1. Acetic Acid-Induced Writing Test
2. The Hot Plate Technique
3. Formalin Test

6. Antimalarial Activity:

Malaria remains a major worldwide health issue that annually affects a great number of people, particularly in underdeveloped nations. Finding effective drugs is a key component of the fight against malaria. we have assessed approximately herbal extracts against Plasmodium falciparum regarded an important medicine. Consequently, found our investigation into the phytochemistry of a few produced numerous strong substances. [30,31]

7.Iron Chelating Activity:

Iron binding herbal extract from *Urginea indica* was determined using the specified protocol. The indication that ferrous ions are present.. Ferrozine added to misture, which started the reaction. Lastly, the samples absorbance at 562 nm and it's percentage were determined. The following equation was utilized to calculate inhibition. [32,33]

FUTURE OUTLOOK AND RECOMMENDATIONS:

Accessibility of *Urginea* subject to fluctuations somewhat constrained due to its exclusive growth on the indian subcontinent. As such, meeting the demand for it as a treatment is a little difficult. Therefore, industrial the cultivation of this wild plant is required. In order to meet market demand, scientists have recently developed an increased interest in growing important medicinal plants in vitro. One such plant is widely used as a therapy for fever, headaches, anemia, and bronchitis.
Furthermore, these plants' genetic material can be utilized in cultivation techniques to promote plant growth, propagation, and secondary metabolite synthesis. These techniques in biotechnology have been used in the past to effectively develop a number of important medicinal plants. [34]
Surprisingly *Urginea indica* may contain proscillaridin, a drug used to treat cardiac arrhythmia and congestive heart failure. Furthermore, due to the constituents' remarkable similarities to the ones found in such as cardiac glycosides, *Urginea indica* is also considered a beneficial replacement utilized heart treatment worldwide.
Also, this plant includes a number of additional compounds that may contribute to its bioactive potential, such as steroids, flavonoids, and bufadienolides. Therefore, either as parts of the plant had been separated by crude extract. *Urginea indica* may be the source of a novel treatment. This plant has also been considered to be equally useful in treating heart-related ailments, therefore it can be used in ayurveda as a substitute for Digitalis purpurea L. (Plantaginaceae). Due to its unpleasant effects, poor absorption, and greater dose requirements, *Ueginea indica* cannot be recommended as a substitute for digitalis because it functions faster and less effectively. [35]
Low permeability drugs can be more effectively absorbed by the gastrointestinal tract (GIT) when administered via a range of drug delivery methods and apparatuses that employ different excipients and

formulations. The greatest way to boost bioavailability and efficacy, particularly in the case of herbal therapies, may be to create polyherbal formulations or apply nanoparticles.
This plant is poisonous, according to reports, however this hasn't been proven by science. By using tests various using a range of animal models, the toxicity of this plant can be evaluated. Preclinical toxicity studies help initiate a product's clinical evaluation; more research on the plant will be required to assess its toxicity concerning its effectiveness across various disease models in vivo.
The majority of studies have used refined compounds; most of the literature now in publication focuses efficacy of that pertinent chemical components that show activity are still unknown, though. Moreover, there are no explicit mechanisms of action or correlations between structure and activity in the material that is currently available.
Structure-activity relationships correlations the separated biological activity components *Urginea indica*. Further investigation is necessary, although some identified pharmacologic properties *Urginea indica* extracts may be related to the aryl hydrocarbon receptor based on the structure of certain components. [36].

CONCLUSION

This study indicates that the consumption of *Urginea indica* bulbs within recommended dosage ranges is considered safe.
Because the herb has long been utilised in ayurveda,5-30 drops (tincture) are recommended. The herb has also historically has been applied topically to treat fungal infections, wound healing, tumour and corn removal. Because there is no toxicity from the plant when applied topically, it's used can be easily accepted. Additionally, a number of *Urginea indica* preparation's studies have demonstrated that *Urginea indica* exhibits anthelmintic, antibacterial, antioxidant, anticancer, antidiabetic, bronchodilator, gastrointestinal stimulant, anti-inflammatory, and wound-healing properties.
However, despite its extensive use in Ayurveda for centuries, clinical studies regarding this significant medicinal plant are lacking. Despite its centuries-old use in Ayurveda. Its favorable, insufficient data, presence suitable. Hence, there is still a significant need for further clinical trials and studies based on this plant.

CONFLICT OF INTEREST

The authors assert that they have no conflicts of interest concerning the investigation.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to all those who contributed to the completion of this review article. Additionally, we would like to thank Dr. D. Y. Patil College of Pharmacy, Akurdi, Pune for providing us with the opportunity to work and contribute to this review article.

REFERENCES

1. Amasta S.P. (1986): The Useful Plants of India. 1st ed. CSIR; New Delhi, India.
2. Shenoy S.R., Kameshwari M.N., Swaminathan S. , Gupta M.N.(2006): Major antifungal activity from the bulbs of Indian squill *Urginea indica* is a chitinase. Biotechnol. Prog.;22: 631–637. doi: 10.1021/bp050305n.
3. Pandey D., Gupta A.K. (2014): Antimicrobial activity and phytochemical analysis of *Urginea indica* from Bastar district of Chhattisgarh. Int. J. Pharm. Sci. Rev. Res.;26: 273–281.
4. The Plant List. Version 1.1. [(accessed on 1 January 2013)]; Available online: http://www.theplantlist.org/
5. Manning J.C., Goldblatt P., Fay M.F. (2004): A revised generic synopsis of Hyacintheaceae in sub-Saharan Afri ca, based on molecular evidence, including new combinations and the new tribe Pseudoprospereae. Edinb. J. Bot. ;60:533–568. doi: 10.1017/S0960428603000404.
6. Stannard J. (1974): Squill in ancient and medieval materia medica, with special reference to its employment for dropsy. Bull. N. Y. Acad. Med.;50: 684–713.
7. Blumenthal M, Gruewald J, Hall T, Riggins, C., Rister R. (1998). The complete German Commission E. Monographs: Therapeutic Guide to Herbal Medicines. Austin, TX: American Botanical Society.
8. Bridgitte Kopp.,Krenn L., Draxler M.,(1996) Bufadienolides from *Urginea maritima* from Egypt. Phytochemistry, 42: 513 – 522.
9. Kameshwari S. (1992): Biosystematics studies of some members of Liliaceae (Doctoral dissertation, Ph. D. thesis. Mysore University, Mysore).
10. Kameshwari MS, Saraswathi KT, Muniyamma M. (2010): Morphological variations in populations of *Urginea indica* Kunth. Liliaceae. J Appl Nat Sci;2: 280-9.
11. Carlquist, S. (1975): Ecological Strategies of Xylem Evolution. University of California Press, Berkeley, CA, USA.

12. Cutter E.G. (1971): Plant anatomy: Experiment and interpretation, Part 2, Organs. Addison-Wesley Publishing Company, London.
13. Uysal I. (1992): Morphological and Ecological Studies on Endemic Plants of Kazdağı (B1 Balıkesir) I "*Allium flavum* L. subsp. flavum var. minus Boiss. and *Muscari latifolium* Kirk.". Turk. J. Bot. 16: 299–310.
14. Prychid C.J., Rudal P.J. (1999): Calcium oxalate crystals in motocotyledons: A review of their structure and systematics. Ann. Bot. 84: 725–739.
15. Shiva Kameshwari (1995): Biosystematic studies in some members of liliaceae, Ph.D. Thesis University of Mysore. 38.
16. Shiva kameshwari M.N. (2011): Epidermal Micromorphology in populations of *Urginea indica* Kunth.Liliaceae. International jour of Engineering Sci & technology. 3:3816-3824.
17. M. N. Shiva kameshwari, A.Bijul Lakshman and G. Paramasivam. A review onBiosystematics studies on medicinal plant Urginea indica Kunth. liliaceae -International Journal of Pharmacy & Life Sciences
18. Johansen, D.A. 1940. Plant Microtechique. McGraw Hill Company, New York & London.
19. Jensen, W.A. 1962. Botanical Histochemistry: Principles and Practice. W.H. Freeman & Co., San Francisco & London.
20. Bayazı TV, Konar V.(2010): Analgesic effects of scilliroside, proscillaridin-a, and taxifolin from squill bulb (Urginea maritima) on PAINS. Digest J Nanomaterials Biostructures (DJNB) ;5: 457-65.
21. Haynes GS. (1906): The pharmacological action of digitalis, strophanthus, and squill on the heart. Biochem J ;1:62-87.
22. Lakshman AB, Paramasivam G. (2012): Biosystematics studies on medicinal plant *Urginea indica* Kunth. liliaceae-a review. Int J Pharm Life Sci;3: 1394-406.
23. Jha S, Sen S. (1981): Bufadienolides in different chromosomal races of Indian squill. Phytochemistry;20: 524-6.
24. Deepak AV, Thippeswamy G, Shivakameshwari MN, Salimath BP. (2003): Isolation and characterization of a 29-kDa glycoprotein with antifungal activity from bulbs of Urginea indica. Biochem Biophysical Res Communications ;311:735-42.
25. Gupta A, Singh SK, Yadav AK. (2015): Pharmacological evaluation of the antidiabetic activity of *Urginea indica* in laboratory animals. Int J Nutr Pharmacol Neurol Diseases; 5:6.
26. Hossain MS, Khalequeuzzaman M, Hasan MN, Islam MA, Rana MS. (2020): Evaluation of anticancer potential of the bulbs of Urginea Indica. Br J Med Health Sci;2:117-2.
27. Rahman MM, Chowdhury JA, Habib R, Saha BK, Salauddin AD, Islam MK. (2011): Anti-inflammatory, anti-arthritic and analgesic activity of the alcoholic extract of the plant *Urginea indica* kunth. Int J Pharm Sci Res;2: 2915.
28. Mikail H.G., Karvouni H., Kotsiou A., Tesseromatis C., Magiatis P. (2015): New alkylresorcinols from a lipophilic extract of *Urginea indica* L. bulbs showing experimental trauma healing activity. Fitoterapia.;101:41–45. doi: 10.1016/j.fitote.2014.12.008.
29. Rahman M.M., Chowdhury J.A., Habib R., Saha B.K., Salauddin A.D.M., Islam M.K. (2011): Anti-inflammatory, anti-arthritic and analgesic activity of the alcoholic extract of the plant *Urginea indica* kunth. Int. J. Pharm. Sci. Res. ;2:2320–2324.
30. Abbas S., Bashir S., Khan A., Mehmood M.H., Gilani A.H. (2012): Gastrointestinal stimulant effect of *Urginea indica* Kunth. and involvement of muscarinic receptors. Phytother. Res.;26: 704–708. doi: 10.1002/ptr.3634.
31. World Health Organization. World Malaria Report 2017; WHO Press: Geneva, Switzerland, 2017.
32. Ebrahimzadeh M. A., Pourmorad F., Bekhradnia A. R. (2008). Iron Chelating Activity, Phenol and Flavonoid Content of Some Medicinal Plants From Iran. Afr. J. Biotechnol. 7 (18), 3188–3192.
33. Sreejayan Rao M. N. (1997). Nitric Oxide Scavenging by Curcuminoids. J. Pharm. Pharmacol. 49 (1), 105–107. doi: 10.1111/j.2042-7158.tb06761.
34. Vinothini K., Sri Devi M., Shalini V., Sekar S., Semwal R.B., Arjun P., Semwal D.K. (2017): In vitro micropropagation, total phenolic content and comparative antioxidant activity of different extracts of Sesbania grandiflora (L.) Pers. Curr. Sci. 2017;113: 1142–1147. doi: 10.18520/cs/v113/i06/1142-1147.
35. Sidhu Y. (2010): In vitro micropropagation of medicinal plants by tissue culture. Plymouth Stud. Sci.;4: 432–449.
36. Gupta S., Kesarla R., Omri A. (2013): Formulation strategies to improve the bioavailability of poorly absorbed drugs with special emphasis on self-emulsifying systems. ISRN Pharm;2013: 848043. doi: 10.1155/2013/848043.