Review Article

Colchicum autumnale (Suranjan): A cytotoxic plant with anti-arthritis properties

Shifali Thakur, Gitika Chaudhary, Hemlata Kaurav*

Shuddhi Ayurveda, Jeena Sikho Lifecare Pvt. Ltd. Zirakpur 140603 Punjab

Received: 12 April 2021

Revised: 27 May 2021

Accepted: 20 June 2021

Abstract

Colchicum autumnale is one of the important plant for herbal formulation. It is a very useful herb that comprises many formulations by Unani Hakeem's. *Colchicum* is a Latin word given by famous botanist 'Dioscorides'. It is generally known as Meadow saffron and Naked Lady. The plant is widely distributed throughout Europe, Denmark, Sweden, European Russia, the Baltic states and New Zealand. In India, Kashmir is the paradise of Meadow saffron and many other medicinal Unani herbs. There are about 70 species in the Genus *Colchicum* and two are native to India. This plant is mostly known for its sedative and resolvent properties. *Colchicum autumnale* is utilized for arthritis, gout and other painful diseases. Various pharmacological activities may have attributed due to bioactive compounds isolated from the plant, mainly alkaloids colchicine, colchicoresin and demecolcine, etc. Colchicine is an alkaloid, which blocks cell division by inhibiting mitosis. The present article has provided a review of the overall description, phytochemical constituents, unani and ayurvedic usage and pharmacological actions of *Colchicum autumnale*.

Keywords: Colchicine, Unani, Anti-Arthritis, Rasa panchak, Toxicity

Introduction

Colchicum autumnale belonging to Liliaceae family, is also known by different names like autumn crocus, naked lady, wild saffron and meadow saffron. Suranjan is one of the known drugs of Unani medicine. There are about seventy species in this genus and two are native to India. According to the Unani system of medicine, the method of treatment is divided into four regimental parts namely diet therapy (Ilaj-Bil-Ghiza), regimental therapy (Ilaj-Bil Tadbeer), surgery (Ilaj-Bil-Yad) and pharmacotherapy (Ilaj-Bil-Dawa). Both single and compound drugs are being used in pharmacotherapy (Ahmed et al., 2017; Baitar 1999). *Colchicum autumnale* is utilized in many polyherbal formulations and prescribed for centuries with a great reputation for the treatment of arthritis and other joint disorders (Ashwini et al., 2011; Razi, 1999). Several classical Greek physicians from Nicander of Colophon, over Dioscorides, Pliny the Elder and Galen, to Alexander of Tralles used this herbal drug for many therapeutic importance since

ancient times (Larsson and Ronsted, 2014). According to some of the classical Unani Books, the original preparation of Majoon Suranjan contained only seven ingredients viz, Asaroon, Zanjabeel, Zeera Siyah, Darfilfil, Sana Maku, Suranjan and Honey (Sushil et al., 2017). The preparation of Majoon Suranjan in the National Formulary of Unani Medicine (NFUM) contains twenty-one ingredients with sugar or honey as a base, whereas, in Hamdard Pharmacopoeia of Eastern medicine, the number of ingredients is the same as that of NFUM but differs in dosage. Its name 'autumn crocus' refers to its flowering time in autumn, whereas the leaves and capsules appear above the ground surface in the following April (Winter et al., 2011). Many Unani Qarabadeen's used this plant for the treatment of digestion, appetizer, inflammation, stomachache, arthritis and phlegmatic diseases (Kabeeruddin, 1957; Khan, 1957; Baitar, 1985). The plant is a primary source of colchicine, which is used therapeutically to treat gout and experimentally in cellular chromosomal studies. Colchicine is an alkaloid isolated in the crocus-like plant. The chemical compound was isolated from the plant by Pelletier and Caventou in 1820. Pernice described the action of colchicine on mitosis, clearly recognizing the drug's shrinking effect of arresting cell

*Address for Corresponding Author:

Hemlata Kaurav
Shuddhi Ayurveda, Jeena Sikho Lifecare Pvt. Ltd. Zirakpur 140603
Punjab, India
shuddhi.research@jeenasikho.co.in

DOI: <https://doi.org/10.31024/apj.2021.6.3.4>

2456-1436/Copyright © 2021, N.S. Memorial Scientific Research and Education Society. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

division in metaphase (Elgsti and Dustin, 1955). The present review article has provided scientific classification, general description, phytochemical constituents, pharmacological action, therapeutic usage of *Colchicum autumnale*. The vernacular names and taxonomical classification (Shah and Qadri, 1995) of *Colchicum autumnale* are mentioned in table 1 and 2 respectively.

Table 1. Vernacular names of *Calchicum autumnale*

Unani	Falheeqan, Aqeemaroona, Balboosa, Falheeq, Asmaroon, Qabaroora
Arabic	Ukba, Laeba barabarbaria, Quln-ul-arz, Surajan hulo
Persian	Haqeer, Surangan, Suranjan shireen
Hindi	Barbari, Jangli singara
English	Colchicum, Meadow Saffron
Persian	Surangan, Gule zangi, Shambleed
Punjab	Suranjan talkh
Sanskrit	Hiranya tutta, Tutham
Kashmiri	Surangan, Virkeum, Moond

Table 2. Taxonomical classification of *Calchicum autumnale*

Taxonomical Rank	Taxon
Kingdom	Plantae
Division	Magnoliophyta
Class	Liliopsida
Subclass	Liliales
Order	Liliales
Family	Liliaceae
Genus	<i>Colchicum</i> L.
Species	<i>Colchicum autumnale</i> L.

Botanical Description of *Colchicum autumnale* L.

Colchicum autumnale L. (Figure 1) is an annual herb with an underground dark brown, scaly, oval shape corm. Leaves are 6 to 12 inches in length and 1/3 to 1/2 inch in breadth. It is rounded in shape and small when it flowers. Flowers are 1 to 2 inches in length and 1 to 1 1/2 inches in the breath. Flowers are hermaphrodite which have both male and female organs. The perianth is funnel-shaped and golden yellow in color. Stamens are six in number. The ovary is sessile, three celled with three long styles. Capsules are septicidal with recurved beaks. Fruits are 1/2 to 1 inch in length and bear seeds. Seeds are 2 to 3 millimeters in diameter and are ovate in shape, light brown to white in color and are bitter to taste. All parts of the plant are extremely poisonous (Singh, 2005; Ali, 2017).

Geographical Distribution of *Calchicum autumnale* L.

Colchicum autumnale grows in wet meadows, woodland clearings and shady rocky habitats on non-calcareous substrates. It may be found up to an altitude of 2000 meters. The plant is native to Great Britain and Ireland. It also occurs across mainland Europe from Portugal to Ukraine, Denmark, Sweden, European Russia, the Baltic states and New Zealand (Parnell et al., 2012).

Phytochemical Constituents of *Calchicum autumnale* L.

Figure 1. *Colchicum autumnale* (Suranjan)

Colchicine, colchicoside, 3-demethylcolchicine are major chemical constituents present in the *Colchicum autumnale* plant (Poutaraud and Girardin, 2002; Ellington et al., 2003). Colchicine is the main alkaloid of the medicinal world, as it has been utilized in the treatment of gout (Rueffer and Zenk, 1998) and has been investigated in many other conditions, including familial Mediterranean fever, cirrhosis and Sweet's syndrome, asthma, liver fibrosis, pericarditis with infusion and Behcet's disease. Recently, allicolchicines (i.e. derivatives of colchicine) and other analogues have reported some exciting effects in cancer cells. This is largely due to allicolchine's ability to halt mitosis by inhibiting tubulin polymerization into microtubules hindering the progress of cells through the cell cycle and leading to the induction of apoptosis. This inhibition of microtubule formation is especially useful in cancer cells that proliferate rapidly and uncontrollably (Larocque et al., 2014; Gründemann et al., 2015). Colchicine is also known for multi-organ toxicity due to accidental intravenous administration. The flowers of *Colchicum autumnale* was consumed for suicidal purpose due to their toxicity. Many colchicine poisoning cases were reported in the last few years (Sussman et al., 2004; Deveau et al., 2014; Marfil et al., 2003; Milne and Meek, 1998). The other alkaloids present in *Colchicum autumnale* L are cornigerine, 2- and 3-demethyl-N-deacetyl-N-formylcolchicine, 2- and 3-demethyldemecolcine and 2-demethylcolchifoline. No alkaloids found without tropolone ring. Figure no. 2 showed some structure of chemical compounds of *Colchicum autumnale* L.

Figure 2. Structure of some major chemical compounds of *Colchicum autumnale*

Traditional and Modern View

Unani System: Unani system of medicine is one among the oldest systems that prevails till date with its efficient drugs derived from animal, plant and mineral resources. *Colchicum autumnale* is the ancient plant used in the Unani system of medicine and is being prescribed for centuries with a great reputation for the treatment of various disorders (Kabeeruddin, 1957; Khan, 1957). The compound formulation of this plant is used as digestive, purgative, anti-inflammatory, appetizer, stomachic, deobstruent, antiarthritic and nervine tonic. It is also indicated for the treatment of phlegmatic disease (Baitar, 1985). The word 'suranjan' probably came from the unani language and is commonly known as 'Suranjaan-e-Talkh' in Urdu, 'Hiranya-Tuttha' in Hindi. Description about Suranjan and its ayurvedic properties are mentioned in Sankar Nighantu by Acharya Sankar Dut Gond in 1935 A.D. Later many other authors of the 20th century like Yadavji Trikamji, K.C. Chuneekar, Ram Sushul sing, have also described it as a specific herbal plant for gout and rheumatic arthritis treatment. PV Sharma has mentioned Suranjana in 'Rakta prasadan varg' i.e. a group of the herbal plant which is helpful in blood purification (Sharma, 2006). There are two varieties of Suranjaan plant i.e. yellow and black and is externally used in swellings and rheumatic affections. Suranjan Shireen is utilized for internal use. The plant possesses the following properties:

- Mushil (Purgative)
- Mushil-e-Balgham (Phlegmagogue)
- Qabiz (Constipation)
- Muhallil (Resolvent)
- Mufatteh-e-sudad (Deobstruent)
- Mukhrij-e-Balgham (Phlegmagogue)

Various Unani medicine formed by Suranjan plant i.e.

1. Habbe suranjan
2. Roghan Suranjan
3. Majun Suranjan
4. Majoon Suranjana
5. Barg e Hina Khushk
6. Badiyan
7. Asarun
8. Beekhe kibr
9. Post halela Zard
10. Turbud Safaid

Ayurvedic View: According to Ayurveda it is divided into three categories based on its rasa panchak. The rasa panchak of Suranjan is mentioned in the table 3 below:

Table 3. Rasa panchak of the Suranjan (*Calchicum autumnale*)

Sanskrit/English	Sanskrit/English
Rasa/Taste	Tikta/bitter, Katu/Pungent
Guna/Physical properties	Laghu/Little, Ruksha/Dry
Virya/ Potency	Ushana/Hot
Vipaka/Metabolism properties	Katu/Pungent

With these properties, its pharmacological actions are kaphavatahara (Kapha-Vata sedative), Cakshushya (clears the vision), Rakta-Prasadan (blood purifier), analgesic, Vran (wound healing), Dipana-Pachana (Boost Appetite), Rechak (relieve constipation), Vamak (Induced vomiting) and Ama vish nashak (also works as an antidotes) (Sharma, 2006). Dried corms (colchici tuber), dry seeds (colchici semen), Hiranya-Tuttha (a dark brown dry extract of *colchicum autumnale*) and fresh flowers are the medicinally used part of the plant (Wink et al., 2004). Each part of Suranjan possesses different therapeutic properties. These

properties are mentioned below:

The dry corm of Suranjan is bitter, pungent and Kapha Vata suppressant, therefore it is used for the treatment of inflammation, swelling, joint pain, gout, sciatica, Osteoarthritis and rheumatoid arthritis. This part is also used in urinary tract-related problems such as stones, Dysurea, urinary tract infection. Hiranaya-Tuttha. It is utilized in many formulations prescribed by ancient practitioners mainly for acute attacks of gout and rheumatism. Seeds are acrid, bitter, astringent and possess anti-inflammatory, analgesic, sedative, aphrodisiac and carminative properties. Flowers of *Colchicum autumnale* are used for the treatment of solid tumors and certain forms of leukemia, especially for chronic myelocytic leukemia.

Modern View: *Colchicum* species, which are widely used as a medication for many years, still remain important in practice. From many reported studies, it is concluded that this plant is also cultivated to use in the pharmaceutical industry. Tropolone alkaloids content of the species help in the treatment of familial mediterranean fever(FMF), gout, amyloidosis, cirrhosis, Behcet's disease, psoriasis, Hodgkin lymphoma, myeloid leukaemia and skin cancers. Many research groups have examined different *Colchicum* species for their alkaloid content (Alali et al., 2007; Al-Fayyadet al., 2002; Khan et al., 2011). In 1970, Prof. Turhan Baytop and Gunay started the studies on *Colchicum* species and it has been continued by Nurhayat Sutlupinar (Baytop and Özcöbek, 1970; Husek et al., 1990; Sutlupinar, 1983). The studies on *Colchicum* species have still being worked by a group of pharma faculty, in Istanbul University, Turkey. *Colchicum* species have been of great economic importance from the past to the present due to their properties in medicine. Due to the high level of toxicity of *colchicine*, the synthesis and isolation studies mostly aim to find derivatives with similar effects but showing lower toxicity. There is vast literature for synthesis methods of *colchicine* but none of them are economical due to their complex procedure. Researchers all around the world focus to find an economic way to produce synthetic colchicine (Toplan et al., 2016). Kumar et al., reported Colchicine as the main alkaloid of the *Colchicum autumnale* plant. Although colchicine is not clinically used to treat cancer because of toxicity but it possesses anti-proliferation effects through the inhibition of microtubule formation by blocking the cell cycle at the G2/M phase and triggering apoptosis. Colchicine can still be used for the generation of potential anticancer drugs (Kumar et al., 2017).

Reported Pharmacological and Therapeutic Activity of *Colchicine autumnale*

Antioxidant Activity: Ahmed et al., (2010) reported antioxidant activity of ethanolic extract and chloroform extract of corms of

Colchicum autumnale. Phytochemically, colchicum offered promising antioxidant activity. The highest activity was found in chloroform fraction i.e. 91% while the overall range was found to be 56-91% (Ahmad et al., 2010).

Antimicrobial Activity: Ahmed et al., (2006) reported antimicrobial activity of methanolic extract of the corms of *Colchicum autumnale*. The crude extract and all the fractions demonstrated moderate to excellent anti-fungal activity against various pathogens. Results showed 75% of antifungal activity against *trichophyton longifusus* and *microsporum canis*. While, the crude extract and subsequent fractions showed antibacterial activity against *Bacillus subtilis* (Ahmad, 2006).

Enzyme Inhibition Activity: The crude methanolic extract and the various fraction of colchicum species including chloroform, ethyl acetate, n-butanol and aqueous were tested against acetylcholinesterase butyrylcholinesterase, lipoxigenase and urease enzymes. The result showed significant enzyme inhibitory activity of crude methanolic extract of *Colchicum* species against lipoxigenase, butyrylcholinesterase and acetylcholinesterase while, no activity was found against urease (Lin et al., 2016).

Anticancer Activity: Lin et al., (2001) investigated the anticancer activity of Colchicine on gastric carcinoma (GC) cells. The result showed that colchicine inhibits the proliferation of gastric cell lines (AGS and NCI-N87 cells) in a dose-dependent manner. Furthermore, the *in-vivo* experiment confirmed that the administration of Colchicine suppresses tumor growth in nude mice (Aisen et al., 2001).

Anti-Alzheimer's and Antioxidant Activity: Sevim et al. reported anti-alzheimer's activity of methanol extract of seeds and corms of *Colchicum* species against acetylcholinesterase (AChE) and butyrylcholinesterase (BChE) using ELISA. Aisen et al., reported anti-Alzheimer activity of colchicine in 20 patients. These patients were treated with hydroxychloroquine 200mg twice daily for 11 weeks, or hydroxychloroquine 200 mg twice daily plus colchicine 0.6 mg twice daily for 12 weeks. The finding revealed that these regimens have anti-Alzheimer activity with no side effects (Sevim et al., 2010). In addition to this, the antioxidant activity of extracts was measured for their scavenging activity with 2000µg/ml-1 concentration of 2,2-Diphenyl-1-picrylhydrazyl (DPPH). The finding revealed that the methanol extract possesses significant antioxidant activity than the other extracts.

Hepatoprotective: Favari et al., (1997) reported hepatoprotective activity of colchicine and silymarin in rats. The doses of colchicine and silymarin were

administrated in rats with liver damage. The finding revealed that both compounds have hepatoprotective action against chronic liver damage (Favari and Pérez-Alvarez, 1997).

Anti-Arthritis Activity: The usage of colchicine in gout treatment was approved in 1987 with a double-blind placebo controlled study. A study was carried on patients with chronic gout arthritis. Patients were separated into two groups, one was administered 0.6 mg of colchicine twice a day and another group was administered placebo for 3 months in a randomized double-blind study. The finding revealed a significant reduction in acute gout crisis in the first group. In a double-blind placebo-controlled study aiming to evaluate the effects of colchicine treatment, 2 groups of 10 familial Mediterranean fever (FMF) patients were orally administered either 0.6 mg colchicine or placebo 3 times a day for 6 months. In 9 patients on placebo treatment, 59 attacks were observed whereas, in colchicine treated patients this number was only 2 patients with 5 attacks. The continuous colchicine treatment was found to be more efficient in preventing arthritis attacks (Goldstein and Schwabe, 1974).

Anti-inflammation Activity: Zemer et al., (1991) reported colchicine to treat and prevent serositis in a patient with familial Mediterranean fever (FML). A study was carried on three hundred fifty children who had FML. The dose of 1-2mg/day Colchicine was given to children for 6-13 years. The result showed none of the children developed amyloidosis while on the colchicine regimen and the side effects of colchicine were mild (Zemer et al., 1991).

Anti-ulceration Activity: Colchicine is widely used in Behcet's syndrome. The effectiveness of colchicine in a 2 years randomized, double-blind, placebo-controlled study among a larger group of patients of both sexes was assessed. The finding revealed that colchicine was significantly effective for Behcet's syndrome in both groups of patients (Yurdakul et al., 2001).

Toxicity: A study was reported that the ground powder of *Colchicum autumnale* is highly toxic to invasive *Solenopsis Invicta Buren*, commonly referred to as red imported fire ants (RIFAs). Ants fed with sugar water containing 5000 mg/l of bulb powder showed 54.67% mortality in three days compared to 45.33% mortality when fed with sugar water containing 50 mg/L of colchicine. After 15 days of feeding, the cumulative colony weight loss reached 44.63% and 58.73% due to the sub-lethal concentration. The result showed that *Colchicum autumnale* could potentially be a botanical pesticide for controlling RIFAs (Lin et al., 2020). A case study was reported on the cytotoxicity of the *Colchicum autumnale* plant. A 24-year-old man consumed '*Colchicum autumnale*' to commit suicide. He was treated in local hospital and shifted to a referral hospital for further treatment on the second day of ingestion. On examination, his

tongue was dry, pupils were normal and reacting to light. He had tachycardia, tachypnoea and hypotension. On the third day of ingestion, patient had episode of diarrhoea with burning sensation and abdominal pain in the epigastric region. The blood pressure and heart rate were low, and the patient developed respiratory distress. He was declared dead following failure of resuscitation measures on 3rd day. Since there is no specific antidote available for treatment of colchicine poisoning. It has to be treated only symptomatically without delay (Nagesh et al., 2011).

Conclusion

Unani system of medicine is one among the oldest systems that prevails till date with its efficient drugs derived from animal, plant and mineral sources. *Colchicum autumnale* (Suranjan) is one of the best Unani plant with lots of health benefits. The plant is also known for its Musakkin (sedative) and Muhalil (resolvent) properties. As per the data of reported studies each of its chemical constituents (like alkaloids colchicine, colchicoresin and demecolcine) is associated with various pharmacological properties. Many reported studies have proved its efficacy in various ailments. However, more scientific studies and clinical trials are needed on this plant to ensure its scientific validation for clinical use in patients.

References

- Ahmad B, Khan H, Bashir S, Ali M. 2006. Antimicrobial bioassay of *Colchicum luteum* Baker. Journal of Enzyme Inhibition and Medicinal Chemistry, 21(6):765-9.
- Ahmad B, Khan H, Bashir S, Nisar M, Hassan M. 2006. Inhibition activities of *Colchicum luteum* baker on lipoxygenase and other enzymes. Journal of Enzyme Inhibition and Medicinal Chemistry, 21(4):449-52.
- Ahmad B. 2010. Antioxidant activity and phenolic compounds from *Colchicum luteum* Baker (Liliaceae). African Journal of Biotechnology, 9(35):5762-4766.
- Ahmad T, Tariq M, Siddiqui JI, Ahmed MW, Kazmi MH. 2017. A Review on *Operculina turpethum*: A Potent Herb of Unani System of Medicine". Journal of Pharmacognosy and Phytochemistry, 6(1):23-26.
- Aisen PS, Marin DB, Brickman AM, Santoro J, Fusco M. 2001. Pilot tolerability studies of hydroxychloroquine and colchicine in Alzheimer disease. Alzheimer Disease & Associated Disorders, 15(2):96-101.
- Ali Mohammad. 2017. Text Book of Pharmacognosy: 2nd edn, 340-341, New Delhi, CBC Publications and Distributors Pvt. Ltd.

- Alali FQ, Tawaha K, El-Elmat T. 2017. Determination of (–)-demecolcine and (–)-colchicine content in selected Jordanian *Colchicum* species. *Die Pharmazie-An International Journal of Pharmaceutical Sciences*, 62(10):739-42.
- Al-Fayyad M, Alali F, Alkofahi A, Tell A. 2002. Determination of colchicine content in *Colchicum hierosolymitanum* and *Colchicum tunicatum* under cultivation. *Natural product letters*, 16(6):395-400.
- Ashwini, R. Gajalakshmi S, Mythili S, Sathiavelu A. 2011. *Terminalia Chebula*- A pharmacological review. *Journal of Pharmacy Research*, 4(9):2884-2887.
- Baitar I. 1985. *Kitab-ul-Jamia Al Mufridaat al Advia wal Aghzia*, pp 130, 127, New Delhi, CCRUM.
- Baitar ZA. 1999. *Al-Jamiul-Mufridat Al-Advia Wal-Aghzia*, pp. 349-52, New Delhi, CCRUM.
- Baytop T, Özçöbek G. 1970. *Colchicum chalcedonicum*, *micranthum*, *szovitsii* ve *turcicum* Alkaloitleri Üzerinde Araştırmalar. *Journal of Pharmacy of Istanbul University* 6, 21(1970):21-26.
- Deveaux M, Hubert N, Demarly C. 2004. Colchicine poisoning: case report of two suicides. *Forensic science international*, 143(2-3):219-22.
- Elgsti OJ, Dustin P. 1955. Colchicine-in agriculture, medicine, biology and chemistry, pp 470, Ames, Iowa State College Press.
- Ellington E, Bastida J, Viladomat F, Codina E. 2003. Supercritical Carbon Dioxide Extraction of Colchicine and Related Alkaloids from Seeds of *Colchicum autumnale*. *Phytochemical analysis*, 14:164–69.
- Favari L, Pérez-Alvarez V. 1997. Comparative effects of colchicine and silymarin on CCl₄-chronic liver damage in rats. *Archives of medical research*, 28(1):11-7.
- Khan AA, Bashir F, Akhtar J, Anjum N, Alam S, Naushin S. 2018. Majoon Suranjan: A Potent Unani formulation for Arthritis. *Journal of Drug Delivery and Therapeutics*, 8(6):351-5.
- Goldstein RC, Schwabe AD. 1974. Prophylactic colchicine therapy in familial Mediterranean fever: a controlled, double-blind study. *Annals of Internal Medicine*, 81(6):792-4.
- Gründemann C, Diegel C, Sauer B, Garcia-Käufer M, Huber R. 2015. Immunomodulatory effects of preparations from *Anthroposophical Medicine* for parenteral use. *BMC complementary and alternative medicine*, 15(1):1-8.
- Husek A, Sütlüpinar N, Sedmera P, Voegeléin F, Valka I, Šimánek V. 1990. Alkaloids and Phenolics of *Colchicum turcicum*. *Phytochemistry*, 29(9): 3058-60.
- Kabeeruddin HM. 1957. *Ikseer e Azam* Ejaz, pp -1430-1447, New Delhi, Ejaz Publishing House.
- Kabeeruddin HM. 1957. *Al Qarabadeen*, pp 413, Faisalbad, Malik son's publishers.
- Khan H, Tariq SA, Khan MA. 2011. Biological and phytochemical studies on corms of *Colchicum luteum* Baker. *Journal of Medicinal plants research*, 5(32):7031-5.
- Khan MA. 1957. *Qarabadeen-e-Azam*, pp- 601, New Delhi, Aijaz Publishing House.
- Kumar A, Sharma PR, Mondhe DM. 2017. Potential anticancer role of colchicine-based derivatives: an overview. *Anti-cancer drugs*, 28(3):250-62.
- Larocque K, Ovadje P, Djurdjevic S, Mehdi M, Green J, Pandey S. 2014. Novel analogue of colchicine induces selective pro-death autophagy and necrosis in human cancer cells. *PLoS One* 9(1): e87064.
- Larsson S, Ronsted N. 2014. Reviewing Colchicaceae alkaloids—perspectives of evolution on medicinal chemistry. *Current topics in medicinal chemistry*, 14(2):274-89.
- Lin S, Qin D, Zhang Y, Zheng Q, Yang L, Cheng D, Huang S, Chen J, Zhang Z. 2020. Toxicity and Sublethal Effects of Autumn Crocus (*Colchicum autumnale*) Bulb Powder on Red Imported Fire Ants (*Solenopsis invicta*). *Toxins*, 12(11):731.
- Lin ZY, Kuo CH, Wu DC, Chuang WL. 2016. Anticancer effects of clinically acceptable colchicine concentrations on human gastric cancer cell lines. *The Kaohsiung journal of medical sciences*, 32(2):68-73.
- Marfil YL, Bueno EV, Jimenez-Caballero E, Marin RD, Villarin AL, Fernandez-Capitan C, Fernández FA. 2003. Suicidal attempt with colchicine. *Farmacia hospitalaria: organo oficial de expresion cientifica de la Sociedad Espanola de Farmacia Hospitalaria*, 27(3):188-90.
- Milne ST, Meek PD. 1998. Fatal colchicine overdose: report of a case and review of the literature. *The American journal of emergency medicine*, 16(6):603-8.
- Nagesh KR, Menezes RG, Rastogi P, Naik NR, Rasquinha JM, Senthilkumaran S, Fazil A. 2011. Suicidal plant poisoning with *Colchicum autumnale*. *Journal of forensic and legal medicine*, 18(6):285-7.
- Parnell J, Curtis T, Cullen E. 2012. *Webb's an Irish Flora*, pp 134-135, Cork University Press.
- Poutaraud A, Girardin P. 2002. Alkaloids in meadow saffron, *Colchicum autumnale* L. *Journal of herbs, spices & medicinal plants*, 9(1):63-79.
- Razi Z. 1999. *Kitab-al- havi* (Urdu translation), pp 25-26, New Delhi, CCRUM.

- Rueffer M, Zenk MH. 1998. Microsome-mediated transformation of O-methylandrocybine to demecolcine and colchicine. FEBS letters 438(1-2):111-3.
- Sevim D, Senol FS, Budakoglu E, Orhan IE, Sener B, Kaya E. 2010. Studies on anticholinesterase and antioxidant effects of samples from *Colchicum L.* genus of Turkish origin. FABAD Journal of Pharmaceutical Sciences, 35:195-201
- Shah CS, Qadri JS. 1995. A textbook of pharmacognosy. Ahmadabad: B.S. Shah Prakasan; 1995-96; 381-383.
- Sharma PV. 2006. Dravyaguna Vigyan, pp 809-811, Varanasi, Chaukhambha Bharati Academy.
- Singh MP. 2005. Medicinal Herbs with their Formulations, pp 279,280, Delhi, Daya Publishing House.
- Toplan GG, Gurer C, Mat A. 2016. Importance of *Colchicum* species in modern therapy and its significance in Turkey. Istanbul Universitesi Eczacilik Fakultesi Dergisi 46(2):129-144.
- Suhail S, Shakir Jamil S, Jilani S. 2017. Phytochemical and Pharmacological Review of Suranjan Shireen (*Colchicum autumnale*). Indo American Journal of Pharmaceutical Resarch, 7(04):8492-6.
- Sussman JS, Brozena SC, Skop N, Korecka M, Shaw LM. 2004. Accidental intravenous colchicine poisoning. Therapeutic drug monitoring, 26(6):688-92.
- Toplan GG, Güler Ç, Mat A. 2016. Importance of *Colchicum* species in modern therapy and its significance in Turkey. İstanbul Üniversitesi Eczacılık Fakültesi Dergisi, 46(2):129-44.
- Winter S, Penker M, Kriechbaum M. 2011. Integrating farmer's knowledge on toxic plants and grassland management: a case study on *Colchicum autumnale* in Austria. Biodivers Conserv, 20(8):1763–87.
- Wink, Michael, Van BE. 2004. Medicinal plants of the world, pp 110, 362, 370, 377, 405, South Africa, Briza publication.
- Yurdakul S, Mat C, Tüzün Y, Özyazgan Y, Hamuryudan V, Uysal Ö, Şenocak M, Yazici H. 2001. A double-blind trial of colchicine in Behçet's syndrome. Arthritis & Rheumatism, 44(11):2686-92.
- Zemer D, Livneh A, Danon YL, Pras M, Sohar E. 1991. Long-term colchicine treatment in children with familial mediterranean fever. Arthritis & Rheumatism: Official Journal of the American College of Rheumatology, 34(8):973-7.