Biochemical Constituents of *Apium graveolens* and *Colchicum autumnale* and Their Role in the Treatment of Diseases

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Contents

Abstract

The plants represent vital sources of healthcare delivery for majority of population all over the world. Medicinal plants are considered as promising therapeutic sources for the treatment of diseases. Heavy metals and micronutrients are essential trace elements of plants, animals and human beings. These essential trace phytochemical constituents of plants play role in redox reaction, nucleic acid metabolism, electron transfer and in various other sites. The effectiveness of plants depends upon the presence of heavy metals and micronutrients. The heavy metals and micronutrients *Apium graveolens* and *Colchicum autumnale* are widely used in natural medicine for the treatment of various ailments.

Key words: Heavy metals, micronutrients, Apium graveolens, Colchicum autumnale, therapeutic plants

Chapter - 1

Introduction

From ancient time the consumption of medicinal herbs and plants having therapeutic effects have played crucial roles in the treatment of various illnesses in both developing and developed countries. Plants are used for the prevention and treatment of diseases in modern pharmacology. At the other hand, plants are best source of food, nutrition, herbal tea, spice, taste condiments and use for many useful purposes in industries (Kitula, 2007; Tercan et al., 2016). Herbs have prime significance in the modern era for developing newer pharmacological products due to their large safety and efficacy with potent therapeutic effects. According to WHO, 70-80% population of people and 30% pharmaceuticals still relies on herbal remedies. Herbal remedies contain highly active component of plants including alkaloids, flavonoids, tannins, amino acids, saponins, glycosides, steroids, quinones, phenols, terpenoids, nutrients, metals and trace elements (Fabricant & Farnsworth, 2001).

Natural medication has picked up significance lately on the grounds that these are viable for human and have low cost. This field is presenting new, protected and effective plant-based drugs. Herbal medicine, natural medicine or traditional medicine is a medicine which is prepared by using the plants and herbs possessing therapeutic potential. Traditional medicine is not used as a main line therapy but with the passage of time tilt has been increasing toward natural medicine due to minimum toxicity and side effects. As an alternative and complementary therapy along with main line therapy, natural medicine has gained momentum. Micronutrients are necessary for human body, animals and plants to function properly due to their growth promoting effect. Heavy metals due to their biological and physiological functioning and possessing therapeutic role used in traditional medicine and are wide spread in environment. For human beings and animals, herbs and plants are vital source of micronutrients. Both the excess and deficiency of heavy metals and micronutrients may cause adverse effects on health of human beings (Underwood, 1997; Reilly, 1980). This study is meant to conduct research wherein the disease prevention activity of heavy metals and micronutrients from medicinal plants is not only parameter considered but other mechanism of action by which plants can combat diseases are investigated.

Heavy metals are heterogenous group of chemical elements having specific weight higher than 5gcm-3(Holleman &Wiberg,1985). Heavy metals have strong propensity to cumulate in human organs, plants and food chain. Some of the heavy metals are toxic and some of them are beneficial for human body. Non-essential heavy metals Cadmium, Mercury and Arsenic are highly poisonous because these metals remain persistent, do not break down easily or metabolized properly result in metal toxicity and even death of organism. In essential heavy metals zinc, copper, indium, iron, molybdenum, manganese, cobalt and nickel are included. These essential heavy metals are also called micronutrients. Theses metals are safe and healthy to indigestion (Reeves &Baker, 2000). Essential heavy metals possess two main functions which are being an integral part of enzymes and participation in redox reaction. In other reactions, Zinc and copper serve as activator and co-factor in enzymatic reactions. Zinc is important metal play important role in cell division, mitosis, as an immunostimulant and necessary for taste and smell Molybdenum are component of nitrate reductase, nickel present in enzyme urease, cobalt complex present in the form of vitamin 12 and iron is an essential component participating in metabolic processes. Manganese by stimulating enzymes plays important roles in metabolism and chemical processes and participates in enzymatic reactions.

The nutritive component of diet required in large amount to provide energy, calories, to human body are called micronutrients. In the most important micronutrients present in plants there are oxygen, carbon, hydrogen, calcium, phosphorus, potassium, nitrogen, sulfur, magnesium, and macronutrients present in human beings are carbohydrates, proteins, fats, dietary fibers, minerals, vitamins and water. Carbohydrates are best source of energy, proteins are needed for growth, maintenance and replacement of tissues, in pharmaceutical industries used as bulking agents, immunostimulants, anti-tumor, anti-coagulant, hypoglycemic and anti-viral (Gurib-Fakim, 2005). Fats are vital component for growth and hormone production, vitamins and minerals play important roles in tissue maintenance, growth and disease prevention. The objective of the study the heavy metals and micronutrients *Apium graveolens* and *Colchicum autumnale* are widely used in natural medicine for the treatment of various ailments.

Chapter - 2

Heavy Metals and Living Organism

Essential heavy metals such as iron, zinc, copper, cobalt, molybdenum and manganese are highly required in varying amount for living organisms. At higher concentration all metals become toxic and can damage to living organism. It has been stated that heavy metals are toxic but the oxides of heavy metals are usually not toxic. For the treatment of APL arsenic trioxide has been approved by Food and Drug Administration (Antman,2001). Mercurous mercury also known as calomel used widely as best anti-septic, diuretic, skin ointment, laxative and vitiligo. Unani *Kushta Tila Kalan and* ayurvedic *Swarna Bhasma are* two gold preparations which are stated to have general tonic, cardiotonic, neurotonic, hepatotonic, cardio-stimulant, anti-aging, anti-microbial, detoxicant and aphrodisiac properties and were used widely in the past (Chopra &Kabeeruddin, YEAR). Now, in modern medicine the gold compounds due to their effect on immune system are used for the treatment of rheumatoid arthritis (Bloom et al., 1988). Gold compounds such as auranofin and gold disodium thiomalate are also used due to their analgesic, anti-cataleptic, anti-depressant and anti-anxiety activities (Bajaj & Vohora, 1998; Bajaj &Vohora, 2000). It was demonstrated by study that Tamra Bhasma which is a time tested metallic ayurvedic preparation used for the treatment of diseases mediative due to free radicles and increased oxidative stress. This experimental study was conducted by using rat models and the results demonstrated that Tamra Bhasma by inducing the activity of SOD inhibit LPO in biphasic manner (Pattanaik, 2003).

Table 1: Human health recommended safe intake and toxic limit of heavy metals

Heavy metals	Recommended safe intake	Toxic level
Zinc	Adults; 15mg/day Pregnant & lactating women; 20-25mg/day	150 ~ g/day
Cadmium	40 to 50 ~gl day	3 mg/day for 2-3 weeks 200 ~ g/kg of fresh weight
Lead	Less than 10µg/dL	Children; 250-550 ~ g/I Adults (in blood); 500 ~ g/I
Chromium	100 and 300 ~g/day	Children; 150~g/day Adults; 12 mg/day

Copper	Children; 1-3mg Adults; 2-3mg	Children; 150~g/day Adults; 12 mg/day
Arsenic	In drinking water;10 μg/L	3 mg/day for 2-3 weeks 200 ~ g/kg of fresh weight
Manganese	Adults; 2.5 to 5.0 mg	More than 5.0 mg
Mercury	43 ~ g	More than 43 ~ g
Nickel	1mg/day	More than 1mg/day

A human being takes heavy metals mostly from the edible parts of plants, soil and drinking water. Heavy metals are necessary and important elements for human beings but some heavy metals are toxic to human beings when they are taken in high concentration. The poisoning effects on body arises when accumulation of heavy metals in body exceeds their sufficient level, then the chances of chronic damage increases. The poisonous effect of heavy metals occurs due to inhalation of paints which are lead based, ingestion of food & medicine from container which are not coated properly, pollution of water & air and exposure to industrial effluents. Some heavy metals are considered carcinogenic and highly toxic to human beings. Zinc when taken in high concentration become toxic and unfavorable effects of acute zinc toxicity are abdominal pain, nausea, vomiting, electrolyte imbalance, lethargy, drowsiness, dehydration, renal failure and muscular incoordination (Prasad & Oberleas, 1976).

In chronic zinc toxicity the unfavorable and toxic effects are anemia, hypercholesteremia, symptoms of Alzheimer disease and damage to pancreas. Copper is another essential element for human beings as it plays a role in the formation of enzymes but in high concentration it becomes toxic for human beings. The signs of copper toxicity are blue green saliva, stool and diarrhea and abnormal renal function. The toxic effect due to high concentration of copper are depression and irritation of CNS, hepatic toxicity, renal damage and capillary damage. Due to the inherited defect in cooper Wilson's disease occur which results in organ failure.

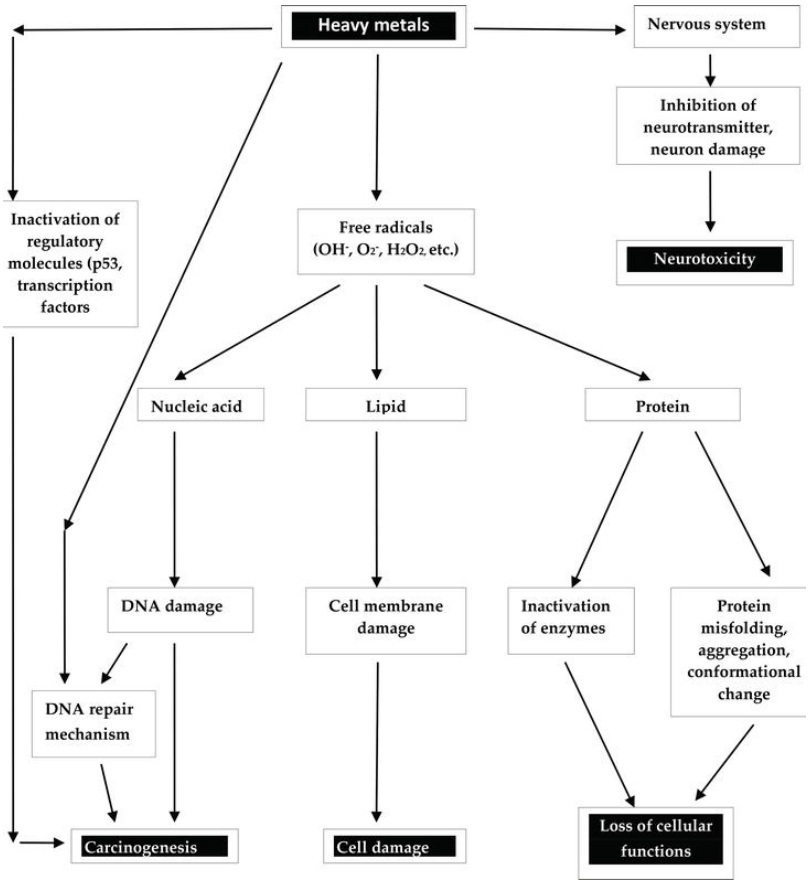

Fig 1: ----------

Lead toxicity mainly occurs due to intake from food and air. Toxic effects of lead mainly disturb the gastrointestinal tract. The severity of lead toxicity led to renal failure, impairment in psychological & neurobehavioral functions, reproductive problem, peripheral neuropathy and cardiac problems. Due to cadmium the problem arises related to health includes cancer of bone marrow & lungs, dysfunction of renal, osteoporosis, osteo-malacia, increased bp (blood pressure), GIT disorder, and bronchitis. CNS related problems occurs due to consumption of manganese, mercury causes gingivitis, tremors, acrodynia, protoplasm poisoning, spontaneous abortion & psychological changes.

Chapter - 3

Heavy Metals and Plants

For plants growth heavy metals play important role such as for the photosynthesis of algae and higher plants copper is considered as essential element. It is a dilemma that likes all other organisms plants often have to face a state in which they become highly poisonous due to the increased concentration of heavy metals. Toxic effects of heavy metals on plants varies according to the species of plants, pH of soil, soil composition, specific metal and concentration of ions. Heavy metals are not only toxic to plants but they are considered as essential elements for the growth of plants. A great number of research studies have been conducted all over the world to investigate the toxic effects due to high concentration of heavy metals to plants (Fernandez & Henariques, 1991; Reeves & Baker, 2000). Some heavy metals are reported to have toxic effect on plant's membrane such as cadmium changes the composition of lipid membrane of plants. It also has been demonstrated that cadmium by increasing the load of free radicles cause oxidative stress which damage the membrane (shah et al., 2000). High concentration of nickel also produces free radicles and oxygen reactive species which cause damage to lipid membrane of plants via increased oxidative stress (Ros et al., 1990).

Micronutrients

The nutritive components which are required by plants in small amount but are highly essential for plants called micronutrients. Many Asian countries are improving their role in cultivation and crop production but these two factors depend upon the fertility of soil which required the availability of essential micronutrients and fertilization. The first micronutrient disorder was occurred in rice crop due to the deficiency of zinc and was named as *hadda* disease recognized in early 1970s. After that the number of experimental and research has been carried out to identify the micronutrients deficiency in soil. Requirement of micronutrients for plants differs in need but highly essential micronutrients are zinc, copper, nickel, iron, boron, manganese, molybdenum and chloride. In human beings and other organisms all these micronutrients play important roles in regulation of metabolic and cellular functions and in the maintenance of homeostasis. The excessive concentration of

micronutrients results in ectopic binding of metals with proteins which lead to the disturbed protein structure. The increased concentration of micronutrients causes the production of reactive oxygen species which result in toxicity of cells (ref.). On the other hand, the deficiency of essential micronutrients in human beings cause various problems and diseases. Every nutritive component plays a significant role in plant nourishing. The plants suffering from micronutrients deficiency show reduced & stunted growth, chlorosis & if deficiency prolongs cell death occurs. The consumption of primary micro-nutrients by plants is more than secondary micro-nutrients (ref.).

Chapter - 4

Nutrients Deficiency & Their Effects in Plants

Plants, like all living things, require food for growth and development. Plants require 16 essential elements. The atmosphere and soil water provide carbon, hydrogen, and oxygen. The remaining 13 essential elements (nitrogen, phosphorus, potassium, calcium, magnesium, Sulphur, iron, zinc, manganese, copper, boron, molybdenum, and chlorine) are obtained from soil minerals and organic matter, as well as from organic and inorganic fertilizers.

Each plant is unique, with an optimum nutrient range and a minimum requirement level. Plants begin to exhibit nutrient deficiency symptoms when the level falls below this minimum. Excessive nutrient uptake can also result in poor growth due to toxicity. As a result, the correct amount of application and placement of nutrients is critical.

Primary Macronutrients

Nitrogen (N)

Available to plants as nitrate (NO3 –) and ammonium (NH4 +) ions.

Nutrient functions

The element N is biologically combined with the elements C, H, O, and S to form amino acids, which are the building blocks of proteins. Amino acids are required for the formation of protoplasm, which serves as the site for cell division and thus for plant growth and development. Because all plant enzymes are proteins, N is required for all enzymatic reactions in a plant. N is an essential component of the chlorophyll molecule and thus required for photosynthesis. N is required for the formation of several vitamins. N improves the quality and quantity of dry matter in leafy vegetables, as well as the protein content of grain crops.

Deficiency symptoms

Due to a reduction in cell division, growth may be slowed. Chlorosis is a pale green to light yellow colour that appears first on older leaves, usually at the tips. Depending on the severity of the deficiency, chlorosis may cause the older leaves to die and/or drop. This is caused by N translocation from older

to younger tissues. The protein content of seeds and vegetative parts is reduced when N levels are low. Flowering is greatly reduced in severe cases. Some crops mature prematurely due to N deficiency, resulting in a significant reduction in yield and quality.

Phosphorus (P)

Available to plants as orthophosphate ions (HPO4 2 –, H2 PO4 –).

Nutrient functions

P plays an important role in energy storage and transfer during photosynthesis and respiration as ADP and ATP (adenosine di- and triphosphate) and DPN and TPN (di- and triphosphopyridine nucleotide). P is a component of the RNA and DNA structures, which are the two main components of genetic information. Seeds contain the most P in a mature plant, and P is needed in large quantities in young cells, such as shoots and root tips, where metabolism is high and cell division is rapid. P promotes root development, flower initiation, seed and fruit development, and seed and fruit development. P has been shown to reduce disease incidence in some plants and to improve crop quality in others.

Deficiency symptoms

The initial overall symptom is slow, weak, and stunted growth because P is required in large quantities during the early stages of cell division. P is relatively mobile in plants and can be transferred to new growth sites, causing symptoms of dark to blue-green coloration to appear on some plants' older leaves. Purpling of leaves and stems may occur in severe deficiency. P deficiency can cause delayed maturation as well as poor seed and fruit development.

Potassium symbol (K)

Available to plants as the ion K+

Nutrient functions

In contrast to N and P, K does not form any essential organic compounds in the plant. The presence of K, on the other hand, is critical for plant growth because K is known to be an enzyme activator that promotes metabolism. K helps to regulate the plant's water use by controlling the opening and closing of leaf stomates, which are where water is released to cool the plant. K is responsible for maintaining the balance of electrical charges at the site of ATP production in photosynthesis. K promotes photosythates (sugars) translocation for plant growth or storage in fruits or roots. K is involved in protein synthesis

due to its role in assisting ATP production. K has been shown to improve disease resistance in plants as well as grain size, and seeds, and improve the quality of fruits and vegetables.

Deficiency symptoms

Chlorosis along the edges of leaves is the most common symptom (leaf margin scorching). Because K is highly mobile in the plant, this occurs first in older leaves Plants lacking K will have slow and stunted growth because K is required for photosynthesis and protein synthesis. If K is deficient, stems in some crops are weak and lodging is common. The size of seeds and fruits, as well as the quantity produced, are reduced.

Chapter - 5

Secondary Macronutrients and Their Effects

Secondary Macronutrients	Nutrient functions	Deficiency symptoms
Calcium (Ca) Available to plants as Ca^{2+}	• Formation of the cell wall membrane. • An activator of several enzyme systems. • Reduces soil acidity.	• The growing tips of roots and leaves turn brown and die. • Buds and blossoms fall prematurely.
Magnesium (Mg) Available to plants as Mg^{2+}	• Mg is as a major constituent of the chlorophyll molecule, actively involved in photosynthesis. • Co-factor in several enzymatic reactions.	• Interveinal chlorosis first appears in older leaves. • Leaf tissue between the veins may be yellowish, bronze, or reddish, while the leaf veins remain green.
Sulfur (S) available to plants as the sulfate ion, $SO_4\ 2^-$	• Essential in forming plant proteins. • Actively involved in metabolism of the b vitamins biotin and thiamine and co enzyme a	• Younger leaves are chlorotic with evenly, lightly colored veins. • Growth rate is retarded and maturity is delayed. • Plant stems are stiff, thin, and woody.
Boron (B) Available to plants as borate, $H_3\ BO_3$	• Promote root growth. • Essential for pollen germination and growth of the pollen tube.	• B deficiency causes stunted growth. • The leaves tend to be thickened and may curl and become brittle.
Copper (Cu) Available to plants as the ion Cu++	• Essential in several plant enzyme systems involved in photosynthesis. • Cu is part of the chloroplast protein plastocyanin.	• Reduced growth • Distortion of the younger leaves • Possible necrosis of the apical meristem.
Chlorine (Cl) Available to plants as the chloride ion, $Cl–$	• Increases cell osmotic pressure and the water content of plant tissues. • Reduces the severity of certain fungal diseases.	• Chlorosis of younger leaves wilting of the plant.

Iron (Fe) Available to plants as Fe2+, Fe3+	• Essential in the heme enzyme system in plant metabolism. • Fe has been strongly associated with protein metabolism.	• Interveinal chlorosis in younger leaves. • The youngest leaves maybe white, because Fe, like Mg, is involved in chlorophyll production.
Manganese (Mn) Available to plants as Mn2+, Mn3+	• Mn primarily functions as part of the plant enzyme system. • Activates indole acetic acid oxidase, which then oxidizes indole acetic acid in plants.	• In monocots, greenish-grey specks appear at the lower base of younger leaves. • In legumes, necrotic areas develop on the cotyledons, a symptom known as marsh spots.
Molybdenum (Mo) Available to plants as molybdate, moo4	• Mo is required by some soil microorganisms for nitrogen fixation in soils.	• Older and middle leaves become chlorotic, and the leaf margins roll inwards. • Deficient plants are stunted, and flower formation may be restricted.
Zinc (Zn) Available to plants as Zn++	• The enzyme carbonic anhydrase is specifically activated by Zn. • Zn has a role in RNA and protein synthesis.	• Interveinal chlorosis along the entire length of the leaf. • In vegetable crops, color change appears in the younger leaves first.

From: Plant Nutrient Management in Hawaii's Soils, Approaches for Tropical and Subtropical Agriculture J. A. Silva and R. Uchida, eds. College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa, ©2000

Chapter - 6

Conventional Medicine

Everyone from Pakistan has wonderful trust in TCAM, which has a year of history. The training/medication is usually temporarily interrupted from time to time, with little attention being paid to the time of ups and downs. The main explanations for using herbs in therapeutic drugs are: 1) multifaceted, evidence-based use, 2) synergistic, and constituent-limiting reactions(Daoudi & Aarab, 2013; Khabour & Kdaimes, 2018). There is further emphasis on the ruinous impacts of the plastics produced. Hence, designs evolve into signature treatments. Internationally there are new examples of the transfer of resources from allopathic systems to standard social security systems. The global market for elective drugs is projected to reach $ 5,000 billion by 2050. The government has shown an interest in incorporating him into the human administration structure while ignoring the various challenges the TCAM is facing. A demonstration called "Tibb-e-Unani, Ayurvedic, Homeopathic, Herbal and Biochemical Medicines Sedate 2010" to control the assembly, storage, import, and customs of conventional medicine has been certified by the Federal Cabinet and the Standing Committee of the National Assembly. Over 300 Pakistani green plants are used in or for the human service system, roughly 12% of the social security system. Ten driving Dawakhanas (herbalists) from Pakistan ate more than 2 million kg of 200 crops each year in the 1990s, while their use has increased many times over in the past two decades. In 1990, 22 types of therapeutic herbs were traded valued at Rs 14.733 million, while that amount had grown to over Rs 122 million by 2002, an eight and a half percent increase. According to one report, an increase in the use of conventional herbal remedies by 600% compared to 1999 was observed(Mukherjee & Chowdhury, 2011).

Pakistan Therapeutic Plants Picture Guide describes more than 500 types of germinating plants used as medicinal products. It has also been shown that about 37% (266 species) of the species mined from restoration facilities. Local species can be similarly searched for ethnobotanical, pharmacological, and drug studies(Kiran & Sood, 2016). In this way, there is a general need to grow and screen crops. In 2006, through the MENTAL, the Pakistani government launched an initiative entitled PMHPS to promote the development of spices

and HMs for harvest in Pakistan. Efforts have focused the therapeutic spice era on a commercial scale through research-based advances that are in line with WHO guidelines on agriculture and conservation strategies (Lamazian & Pidchenko, 2019; Menon & Jayakumar, 2014; Olushola-Siedoks & Igbo, 2019). The NIH, Islamabad, Pakistan, coordinated various workshops with the particular aim of blending the Western biomedical and conventional medicine sectors in the regions(Lamazian & Pidchenko, 2019; Kiran & Sood, 2016).

In 2002, an exhibition of HMs was held in Islamabad, attended by more than 150 members from Pakistan and the ASACR region. About 20 local prescription organizations were interested in the presentation. There are many problematic small businesses in Pakistan dealing in conventional and HMs.

Chapter - 7

Medicinal Plants and Their Role in the Treatment of Diseases

7.1 *Apium graveolens*

Apium graveolens is commonly known as celery and ajmod belongs to Apiaceae family (Norman et al., 2001).

7.1.1 Description

In early 1600s it was cultivated as food plant because it contains fats, provides energy and rich source of vitamin C (Kooti et al., 2015). This is a perennial plant having whitish or greenish small flowers. This plant has slightly bitter and aromatic fruit. All parts of this plant were used for home or herbal remedies. Being best flavoring agent, it is used widely in food industries.From past, celery has been used in both food and traditional medicine. Medicine emergence happened in late 19^{th} century and celery juice was used to stimulate digestion.

7.1.2 Vernacular Names

In different languages Apium graveolens has different names. In other languages, it is known as seen in table 2.

Table 2: Vernacular Names

Urdu	**Tukhm -e-Karafs**
Persian	Karafs
German	Sellerie
Spanish	Apio
Arabic	Alkarafs
Chines	Ch'in-nst'ai
Hindi	Ajmoda, Ajmud, Bhut-jata
Hausa	Seleri
Japanese	Oranda-mutsuba

Table 3: Taxonomy

Kingdom	Plantae
Subkingdom	Viridiplantae
Division	Spermatophytes.
Sub-division	Angiospermae
Class	Magnoliopsida
Order	Apiales
Family	Apiaceae
Genuus	Apium L.
Species	Apium graveolens L.

7.1.3 Geographical Distribution

This plant has origin from swamps & wild plant and are wide spread in Europe and Asia (turner et al., 2011). As a food plant this plant was cultivated for the first time in 1623 in France. Apium graveolens has natural habitat of Italy. This plant is cultivated widely in developing countries including Indonesia, Caucasus, India, Algeria, Iran and Abyssinia (Bruznican et al., 2019). India is a wide cultivator of celery and it is reported that 40,000 tons are produces and 250 tons are exported per year (Kolarovic et al., 2009). In Iran celery is cultivated in Sistan, Zabo, Tehran, Baluchistan, Semnan and Khuzestan (Kooti et al., 2014).

7.1.4 Botanical Description

Apium graveolens belongs to genus Apium L. and family Apiaceae. The genus Apium contains 20 species in it. Variability exists in the morphology, color, flavor and chemical composition of this plant but there is no other plant which is commonly named as celery. Apium graveolens is a biennial herbaceous plant of approximately 100 cm in height with branches and fleshy stems. Each umbrella of celery averagely contains four to twelve branches. The leaves of celery attain length 5-50mm and are found in spear, diamond or triangular shape with saw-teeth or lobe shaped edges (Lim,2015) . The leaflet of this plant 3-lobed and ovate to suborbicular. The calyx of this plant has absolute and stem of celery is moist, ribbed and branched. The root system of this plant is in the form of shallow tape. The color of small flowers of this plant is usually white or greenish white and wingless fruit appear in brown color containing black lines on outer layer and is aromatic having diameter of 1-2mm (Amirghofran,2010). Seeds of this plants present on oval shaped and of 1.5-2mm in size. The carpels are sub pentagonal while the ridges are discrete and primary. Each carpel contain one seed and 2 Carpel unite to made one fruit. The flower of this plant contains 5 petals in oval shape with floured

tips. The taste of spice is pungent but the aroma is usually pleasant (Sowbhagya, 2014).

Fig 1: *Apium graveolens*

7.1.5 Cultivation

Celery usually grow on cloudy and cold places and has minimum tolerance to heat. Cold temperature and Long dry season are considered best for the cultivation of *Apium graveolens*. The temperature required by the celery usually ranges from 12°C - 15°C and 22°C-25°C. for sowing of seed march and April are suitable months and for the transplantation of seeds, May is a appropriate month. The proper harvesting of celery is done in November. Celery can grow in all type of soils but the loamy &water-logged soils are good while the saline and alkaline types soils are not suitable as such. The suitable pH of soil for the cultivation of this plant should be 5 to 7 (Fazal& Singla, 2012).

7.1.6 Chemical Composition

The chemical composition and contents present in medicinal or all plants mainly depends on the number of factors which are genetics, ontogenetic, agronomic and environmental factors (including used fertilizers and irrigation

or cultivation methods). It has high caloric value due to the high fat contents. Due to the presence of essential oils and volatile oils this plant possesses characteristic odor. This medicinal plant is a best source of minerals such as Iron, calcium, phosphorus, potassium, magnesium and sodium (Chopra& De, 1929) .

7.1.7 Seeds

The carbohydrates, proteins, fats, vitamin A, B, C, volatile oils, fibers, moisture and ash present in the seed of this plant (Keller&Matile,1989). The major component present in seed is limonene (80%). The other chemical constituents present in the seeds of celery are a-p-dimethylstyrere, thymol, N-pertyl benzene, trans-8-diene 1-ol, caryophyllene, paraldehyde, a-selinene, carvone, N-butyl phthalide, alpha-terpineol, sablnene, trans-p-menth-2,8-diene-1ol, b-elemne, 1-cis –p-menth-2,8-diene-1-ol,trans-1 2epoxylimonene, trans-dihydrocarvone, trepinene-4-ol, linalool, cis-dihydrocarvone and isovaleric acid [Orient, 1996 ;Government of India, 1990 ; Yan et al., 1998 ; Ghosh et al., 1929). The trace elements present in the seeds of Apium graveolens are calcium, magnesium, sodium, potassium, iron, copper, manganese and cadmium.

7.1.8 Leaves and Stalk

Chemical constituents and trace elements present in Apium graveolens are moisture, protein, fat, fibers, mineral matter, calcium, phosphorus, iron, sodium, magnesium, potassium, vitamin A, vitamin B, vitamin C, folic acid, chlorophyll and silica. The flavoring agents of Apium graveolens also present in the leaves and stalk of this plant. 3-Butyl 4, 5 dihydrophthalide and 3-n-Butylphthalide are two important flavoring lactones present in leaves and stalk. Leaves and stalk of celery plant are rich in essential oils and beta-carotene. Nine essential oils containing sesquiterpene, limonene and salience also present in Apium graveolens (Chopra et al., 1929).

7.1.9 Stem

The chemical constituents present in the stem of Apium graveolens are d-galactose, 1-rhamnose, 1-arabinose and d-galacturonic acid. All these chemical constituents are component of pectic polysaccharide known as apiuman (Ovodova et al., 2009).

7.1.10 Root

The roots of Apium graveolens contain polyacetylene 8-O-methylfalcarindiol, panaxydol, falcarindiol and falcarinol (Zidorn et al., 2005).

Table 3: Nutritional constituents of *A. graveolens*

Nutritional constituents	Seeds	Leaves	Petioles	Stem
Water	6	81	96	95
Energy	392	64	29	34
Fat	3	0.6	0.1	0.1
Protein	18.1	6	0.7	0.9
Carbohydrate	41.4	8.6	1.2	1.2
Iron	1767	23	0.3	0.5
Potassium	547	14	27	34
Calcium	17	6.3	25	10
Magnesium	45	6	10	14
Vitamin	52	80	90	120
Niacin	Trace	Trace	0.3	0.3
Riboflavin	Trace	Trace	0.04	0.02
Thiamine	Trace	Trace	0.03	0.03

7.2 Medicinal Activities

7.2.1 Anti-diabetic Activity

Rosa et al. (2014) investigated the antidiabetic and antiglycation effect of *Apium graveolens*. Diabetic rats were treated with chloroform extract. The result of test showed good effect on hyperglycemic rats. The study revealed that plant extract of *Apium graveolens* show antidiabetic and antiglycation activity by due to its anti-oxidant potential effect the enzyme present in liver, kidney, pancreas, by decreasing glucose and level of low-density cholesterol and triglycerides. The extract has beneficial effects on high-density cholesterol, alanine aminotransferases, aspartate, alkaline phosphatase, insulin & pancreas. It was observed that the level of Gluconeogenic enzyme was increased and the level of hexokinase was reduced. The extract of *Apium graveolens* showed significant antiglycemic activity in in vitro experimentation. The result of experimentation demonstrated that extract significantly improves the metabolism of glucose by decreasing the insulin resistant and has protective effect on the cell of pancreas.

7.2.2 Renal Protective Activity

Ata et al. (2015) found the *Apium graveolens* as potent diuretic and renal protective agent. The experimental study was conducted on Wister rats of both sexes and animals were divided into 8 groups. Ethanol was used to obtain root extract by using Soxhlet extraction method. Ethanol extract of this medicinal plant showed significant difference in the volume of urine and it was

concluded from experiment that ethanolic aqueous extract of the root of *Apium graveolens* has diuretic activity. No abnormal excretion of creatinine, protein and electrolytes was observed. In fact, the extract causes the less excretion of sugar in urine due to the hypoglycemic activity. Faris et al. (2018) conducted an experimental study to evaluate the diuretic activity of *Apium graveolens* during the time period January 2018 to June 2018 in AL-Qassim green university by using rat models. After the statistical analysis the result of study showed that ethanolic extract of *Apium graveolens* possesses significant diuretic activity.

7.2.3 Anti-Hypertensive Activity

Moghadam et al. (2013) investigated the anti-hypertensive activity of seed extract of *Apium graveolens* on normotensive rat and deoxycorticosterone acetate induced rat. By administrating the seed methanolic, ethanolic and hexanic extract intraperitoneally the effects of results were evaluated on blood pressure and heart rate. And the number of hypertensive constituents n-butylphthalide present in seed extract was determined and evaluated by high performance liquid chromatography. The result of this experimental study demonstrated that seed extract of *Apium graveolens* increase heart rate and decrease blood pressure in hypertensive rats. From HPLC. it was also indicated that the concentration of n-butylphthalide in hexanic extract is four times greater than the methanolic and ethanolic extract. From the result of study, it was indicated that n-butylphthalide play significant anti-hypertensive activity in chronic elevated blood pressure.

7.2.4 Anti-Oxidant Activity

Wesam et al. (2017) studied the anti-oxidant activity of *Apium graveolens* (commonly known as Celery) by using different sources such as PubMed, science direct, springer and Scopus. *Apium graveolens* was found to prevent gout, hepatic disorders, cardiovascular disorder, lower blood glucose and blood pressure. Celery plant also improve fertility, decrease cholesterol and possess anti-asthmatic, anti-bacterial, anti-fungal, anti-oxidant, anti-inflammatory, analgesic, anti-allergic, anti-pyretic and anti-cancer activity. In present study, 980 articles were collected to extract data on celery and use of celery plant in different studies. 9 studies out of the total article met the criteria and was divided into two group in vivo and in vitro. The in vivo studies conducted on rat treated with doxorubicin showed that doxorubicin have strong anti-oxidant potential by reduce glutathione contents. The in vitro studies anti-oxidant contents present in the leaves of *Apium graveolens* were

evaluated through high performance liquid chromatography and spectrometry. The result of study shows the presence of apigenin, saponins, kaempferol, luteolin. Ferulic acid, tannins, caffeic acid and p-coumaric acid. All these constituents possess promising anti-oxidant activity

7.2.5 Anti-Cancer Activity

Rakhad et al. (2018) designed study to evaluate the anti-cancer activity of seed extract of *Apium graveolens* (Celery) by using in vitro method. Cancer is a major leading cause of death all over the world. *Apium graveolens* demonstrated as significant plant to treat cancer due to the presence of cancer fighting agents which are apigenin, luteoline, apiuman, chrysoeriol, polyphones and various polycetylenes. The result of the study revealed that celery has clear cytotoxic activity against cancerous cells. It was also revealed from the result of study that hexane extract of *Apium graveolens* shows more cytotoxic potential against the growth of cancer cell line at the concentration of 100 or 200 ug/ml.

7.2.6 Anti-Microbial Activity

Lena et al. (2019) investigated the anti-microbial activity of methanolic extract of *Apium graveolens*. The researchers analyzed the anti-bacterial and anti-fungal activity of this plant by collecting plant material. Then they socked the 20gm sample of plant powder into 100ml methanol and left for 16 hours. By using Whatman No. 1 filter plant extract was separated. By using sodium sulphate, the further filtration was done to remove trace elements. The filtrate was treated for FTIR spectroscopy at the range between 400nm to 4000nm. The plant material shows strong anti-microbial activity against *Aspergillus terreus* (5.01±0.17) and methanol extract of plant have anti-microbial activity against *Klebsiella pneumoniae* (4.27±0.16) due to the presence of Fluconazol, Amphotericin B, alkyl halides, alkanes and amides.

7.2.7 Neuro-Protective Activity

Jinnata et al. (2020) found the *Apium graveolens* as best neuroprotective against cerebral ischemia. Stroke is a neurological disorder characterized by loss of brain function due to disturbance of cerebral blood flow to brain. *Apium graveolens* was reported to several promising therapeutic activities such as anti-oxidant, anti-apoptotic, anti-fungal and anti-inflammatory, cardioprotective, lower blood glucose level, strengthen the heart and decrease blood pressure. In present study, Wister rats were administrated orally for 14 days with the extract of *Apium graveolens*. Result obtained showed that extract of *Apium graveolens* commonly known as celery improve the neuronal density of hippocampus and cerebral. *Apium graveolens* helps in reducing the

cognition damage due to its neuroprotective activity attributed to its antiapoptotic, anti-oxidant and anti-inflammatory activity.

7.2.8 Hepatoprotective Activity

Singh and Handa (1995) investigated the hepatoprotective activity of the methanolic seed extract of *Apium graveolens* in India on paracetamol or thioacetamide induced liver damage. The results of study indicated the significant anti-hepatotoxic activity of seed extract of celery. Ahmad et al. (2002) investigated the hepatoprotective activity of *Apium graveolens* against ccl4 induced liver ailments in Albino rats. By using the biochemical parameters such as alkaline phosphatase, serum transaminases, albumin and total protein the degree of protection was measured and was compared with standard hepatoprotective drug silymarin. The result of study revealed that methanolic extract of *Apium graveolens* has significant hepatoprotective activity. Another experimental study demonstrated that root extract of *Apium graveolens* increases the level of ALT and AST and reduce ccl4 significantly and protect liver from damage.

7.2.9 Anti-Inflammatory Activity

Mencherini et al. (2010) investigated the anti-inflammatory activity of the extract of *Apium graveolens.* The extract of celery consisting of Apiin chemical constituent showed anti-inflammatory activity against iNOS and play promising anti-inflammatory activity. Lewis et al. (2008) conducted experimental study to investigate the anti-inflammatory activity of aqueous extract of *Apium graveolens* by using 2 animal models. From the result of study, it was showed that mannitol and phytosterol present in aqueous extract of *Apium graveolens* play important anti-inflammatory activity and used for the treatment of rheumatic ailments. Ramezani et al., (2009) investigated the anti-inflammatory ana anti-nociceptive activity hexane and aqueous seed extract of *Apium graveolens* in formalin and xylene induced edema rat. The result of test was compared to control group and fraction were admistered intraperitoneally. The result demonstrated that seed extract of *Apium graveolens* possesses remarkable anti-inflammatory and anti-nociceptive activity.

7.2.10 Spasmolytic Activity

Brankovic et al. (2015) investigated the experimental study to determine the spasmolytic activity of ethanolic and aqueous leaves extract of *Apium graveolens* on rat models. The study was carried out by using albino rats ileum fragments and mesenteries were cleaned out. After the statistical evaluation the result of study indicated that aqueous ethanolic extract of *Apium*

graveolens significantly decreased tension on muscle of ileum. In concentration dependent manner aqueous ethanolic extract exert relaxant effect on muscle contraction induced by acetylcholine. Shamkuwar (2020) investigated the anti-spasmodic activity of the extract of *Apium graveolens* by using pig ileum model and contraction was induced by using acetylcholine, histamine and nicotine. The result of this experimental study indicated that extract of *Apium graveolens* possesses remarkable anti-spasmodic efficacy by inhibiting the contraction via inhibiting the receptors. Anti-spasmodic activity of extract of *Apium graveolens* was compared with atropine a standard drug and results demonstrated the potent anti-spasmodic activity of celery.

7.2.11 Anti-Dandruff Activity

Nikita et al. (2021) investigated the anti-dandruff activity of *Apium graveolens* by preparing the extract of *Apium graveolens* through hydro distillation by using alcohol. The seed extract of celery plant showed remarkable anti-dandruff activity. As dandruff occur due to fungi named as Pityrosporum oval. The result revealed that due to the potent anti-fungal activity celery plant is best to prepare hair gels or anti-dandruff hair shampoo.

7.2.12 Anti-Pyretic Activity

Bursac et al. (2006) conducted an experimental study to evaluate the anti-pyretic activity of methanol ethanolic extract of *Apium graveolens* by using rat animal model. The rats were divided into five groups and there were five animals in each group and rectal or basal body temperature was measured with the use of thermometer after every 30 minutes within 5 hours daily. After the statistical evaluation the result of study demonstrated the potent anti-pyretic activity of methanol ethanolic extract of celery.

7.2.13 Anti-Platelet Activity

Ma et al. (2012) investigated the anti-platelet activity of 3-butyl-6-bromo-1(3H)-isobenzofuranone (Br-NBP) which is an important chemical constituent of *Apium graveolens.* For the conduction of this experimental study rat models were used and platelet aggregations was induced by AA via in vitro and in vivo experimentation. The result of this experimental study demonstrated that 3-butyl-6-bromo-1(3H)-isobenzofuranone (Br-NBP) played remarkable anti-platelet activity and inhibited the platelet aggregation by inhibiting the Ca^{2+} mobilization and thromboxane B_2 formation induced by AA. It was also revealed from the result of this study that treatment with 3-butyl-6-bromo-1(3H)-isobenzofuranone increases the synthesis of NO & increases the level of cGMP and cAMP. Another experimental study evaluated the apigenin as active constituents of *Apium graveolens* found in extract has

remarkable anti-platelet activity by inhibiting the AA, collagen and ADP induced aggregation of platelet in blood (Teng et al., 1998).

7.2.14 Effect on Fertility

Hardani et al. (2015) investigated the effect of aqueous extract of the leaves of *Apium graveolens* on spermatogenesis. Celery has been used widely for the treatment of impotency in traditional medicine. The study was carried out on the spermatogenesis and testicular tissue on healthy adult male rat. After the histological studies and epididymal sperm count the result of this experimental study indicated that aqueous extract of *Apium graveolens* significantly increased the diameter of seminiferous tubules and increased sperm count. It was concluded from the result of study that celery has remarkable effect on spermatogenesis and used in the treatment of fertility problems. Kooti et al. (2014) conducted an experimental study to evaluate the effect of hydroalcoholic extract of the leaves of *Apium graveolens* on the testicular structure and number of sexual cells by using male rat. The result of study demonstrated that of hydroalcoholic extract of *Apium graveolens* remarkably increased the number of sperms and increase spermatogenesis.

7.2.15 Cardioprotective Activity

Asmari et al. (2017) described cardioprotective activity of *Apium graveolens* in his review paper. The data of that review was collected from the recent studies published in "PubMed", "Google scholar", "Scopus', "Science direct" and "Web of Science". According to the result results of different studies that apigenin is an important constituent of celery play remarkable cardioprotective activity by inhibiting the contraction of aortic ring induced by suppressing calcium ion concentration in high potassium medium via both receptor & voltage operated calcium channels (Ko et al., 1991). Cardioprotective activity of celery juice was examined by using the rat model in which cardiotoxicity was induced by doxorubicin and the result of study showed the significant cardioprotective activity after measuring the level of different enzymes in liver (Kolarovic et al., 2009). In another experimental study it was demonstrated that another constituent of *Apium graveolens* named as 3-butylpathalide possesses remarkable cardiotonic activity by inhibiting the release of glutamate from synaptosomes and decreasing the nitric oxide contents (Zhang et al., 1999).

7.2.16 Hypolipidemic Activity

Mansi et al. (2009) investigated the hypolipidemic activity of ethanolic extract of *Apium graveolens*. This experimental study was conducted on adult male Albino rats in university of Jordan. The result of study indicated that

ethanolic extract of *Apium graveolens* significantly cause reduction in weight of test group and results were compared to control group. From this experimental study it was showed that ethanolic extract of *Apium graveolens* by stimulating the metabolism, increasing energy expenditure, suppressing the appetite, inhibiting the activity of lipoprotein lipase play significant hypolipidemic activity. D and UK (2011) investigated the hypolipidemic activity of ethanolic extract of *Apium graveolens* and its chloroform fraction in experimentally induced hyperlipidemic rats. The result of study after phytochemical screening showed the presence of sterols, flavonoids, glycosides, alkaloids, tannins and terpenoids and demonstrated that ethanolic extract and fractions of *Apium graveolens* by increasing HDL, decreasing LDL, TC and TG play promising anti-hyperlipidemic activity.

Colchicum autumnale, commonly known as meadow saffron, naked boy, naked ladies and autumn crocus, it looks like true crocuses however it's far specie of colchiceceace.

8.1 Description

This herbaceous perennial has leaves up to 25 cm (10 in) long. The flowers are solitary, 4–7 cm (2–3 in) across, with six tepals and six stamens with orange anthers and three white styles. At the time of fertilisation, the ovary is below ground (Blamey et al., 2003). Colchicum is flower bearing toxic plant. Colchicine looks like crystal and of light yellow in color, shapeless or in powder form. It has bitter taste and is scentless. It obscures in air. Colchicine unreservedly dissolvable in liquor and chloroform, dissoluble in 25 pieces of water and in 220 pieces of dissolvable ether. It is planted in temperate areas as a decoration.(Nagesh et al., 2011).

8.1.2 Vernacular Names

In different languages *Colchicum autumnale* has different names. In other languages, it is known as seen in table 4.

Table 4: Vernacular Names

Urdu	Suranjaan Shireen
Persian	Suranjaan, Zafranalfazar
German	Herbsttulpe, Herbstzeitlose
Spanish	AzafránBastardo
Arabic	Akna, Haferel-mohar
Chines	Qiūshuǐxiān
Hindi	Hirantutiya
Japanese	Inusafuran, Koruchikamu
French	Chénarde
Tur	Aciçiğdem

Table 5: Taxonomy

Kingdom	Plantae
Clade	Tracheophytes
Clade	Angiosperms
Clade	Monocots
Order	Liliales
Family	Colchicaceae
Genus	Colchicum
Species	C. autumnale

Geographical distribution

C. autumnale is a native plant of south, west and central Europe, extending to the eastern banks of the Black Sea, in Georgia (Bruneton, 1995; Tutin et al., 1980). The plant is cultivated throughout much of the world, primarily as an outdoor ornamental.

Botanical Description

This plant is a crocus plant and such plants are cultivated due to their ornamental flowers and belongs to lilly family. *Colchicum autumnale* is a perennial, small herbaceous toxic plant with 10-4-cm height. The leaves of this plant are shiny, lanceolate and dark green in color having size of 15-35cm. flowering typically occur in autumn from August to October and leaves appear in spring from April to July. Fruit of this plant are oblong to Ovid in shape and green to brown in color containing many seeds. The flowers of this plant originated from underground bulb and first show pink color then become purple to white.

Flowers appear in groups as 1-6 having about 3-4.5cm large petals and

found fused with stalk of this plant which is almost 5-20cm long. This plant has thickened, underground, vertical stem which attain height of 2.5 to 6cm with brown tunic covering. This plant usually grown in woodland, wet shadow and rocky habitat. This is a toxic plant containing toxin in all of its parts. Colchicine is a major toxin found in all parts of this plant but have low concentration in leaves. Phytochemical constituents of this plants are freely soluble in water, chloroform and alcohol and partially soluble in in petroleum ether. The fleshy corm of this plant possesses reddish like odor and bitter taste.

Fig 2: *Colchicum autumnale*

8.2 Cultivation

Meadow saffron is not a domestic plant, it is toxic plant and used specifically for the therapeutic purposes. In nature colchicum autumnale possess an unusual life cycle through which it propagates from mother corm. Mother corm produces one or sometimes two daughter corm every year and the harvesting of seeds generally occurs in June. This plant start blooming in September, rooting phase starts in in October and completed till January and produce fruit in month of June. By the propagation of seed drug is obtained in Jammu and Kashmir and many other regions of the world (Jaehn, 1984;Godet, 1987).

8.3 Chemical Constituents

Colchicine is the chief part of its seeds having" Colchicine" additionally have "demecolcine". both alkaloids contain "tropolone" or "cycloheptatriene-ol-one ring"structure. Colchicine is a particular concoction constituent for treatment of gout and stiffness of joints and for rheumatoid arthritis. colchicine possesses properties against tumor activity, aside from restorative use, colchicine is broadly acknowledged and rehearsed as a synthetic operator for bringing the polyploidy and henceforth utilized in agriculture and development of therapeutic plants(Hongping & Fuchu, 2000)"Colchicum-

luteum" (CL) has been ordinarily utilized for joint infirmities like gout and rheumatoid joint inflammation in different plans for treatment and the board of ligament torments like osteo joint inflammation, rheumatoid arthritis, gout and many more.

For assessment of colchicum property against joint pain. "CL-hydroalcoholic" remove ("CLHE") in "formaldehyde" and complete Freund's adjuvant ("CFA") prompted joint pains (Akbar, 2020). Joint inflammation was initiated by organization of "CFA" into subplantar surface of rear paw of animal. Inflammation of joints was estimated on days 8, 9 and 10 in formaldehyde instigated joint pain and days 3, 7, 14 and 21 in "CFA" actuated joint inflammation. So as to assess the impact of "CLHE" on sickness movement, serum "TNF"-Î± level and synovial articulation of proinflammatory middle people (TNF-R1, IL-6 and IL-1î²) was resolved in CFA actuated joint inflammation. "CLHE" delivered a critical and portion subordinate hindrance of joint swelling during the given time.

Serum TNF-Î± level was additionally decreased altogether in a dose dependent manner. statement of proinflammatory arbiters (TNF-R1, IL-6 and IL1î²) was additionally discovered to be less in the "CLHE" regarded bunch when contrasted with control. We accept antiarthritic action of "CLHE" was because of its modulatory impact on the outflow of cytokine in the synovium. Our outcomes attribute towards approval of the conventional utilization of CL in management of RA, colchicine, interact with cellular tubulin protein and inhibit macrophages, cytokines TNF-α, IL-6 and IL-1β in inflamed tissue.(Farzaei et al., 2016).

Seeds

All parts of the plant contain toxins. The greatest concentration of toxins is found in the seeds and the bulb (corm) (Cooper & Johnson, 1984; Frohne & Pfänder, 1983). 2.5 g of seeds and 25 g of tincture contain 10 mg colchicine. Although colchicine has been used for several diseases including neoplastic and allergic diseases, and as a diuretic, it is currently almost exclusively used as a pharmaceutical in the treatment of gout attack and familial Mediterranean Fever.

Leaves

lanceolate, dark green, shiny (15 to 35 cm x 2 to 7 cm). They appear in the spring, then die back before the flowers appear. The leaves contain very low amounts of colchicine (Gessner & Orzechowski, 1972). Flowers: showy pink, purple to white flowers in groups of 1 to 6 are produced from an underground bulb. Each petal is about 3 to 4.5 cm long and is fused below into

a pale stalk-like tube 5-20 cm long. Colchicine is present in the flowers (0.1 to 0.8% in fresh flowers; up to 1.8% in dried flowers). (Gessner & Orzechowski, 1972).

8.4 Medicinal Activities

8.4.1 Anti-thyroid Activity

Scheffer et al. (2009) found that Colchicum autumale used for the treatment of thyroid disorders by carrying out observational study on 18 patients. Colchicum autumnale is commonly known as Autumn crocus, suranjan Shireen and meadow saffron belongs to colchicaceae family. The plants belonging to colchicaceae family mostly used for therapeutic purposes due to their anti-inflammatory, anti-oxidant and anti-tumoral activities. This plant is demonstrated as to have best potential against hyperthyroidism. After the clinical trials of 3 month the hyperthyroidism symptoms were significantly reduced and free thyroxine and triiodothyronine were observed. The result of the study revealed that Colchicum autumnale has positive effect on hyperthyroidism.

8.4.2 Anti-arthritisActivity

In 1st century A.D the extract of Colchicum autumnale was used for the first time by Dioscorides in De Materia Medica for the treatment of arthritis (Trease& Evans, 2009). Siddiqui and Akhtar (2018) described the role of colchicum autumnale for the treatment of arthritis according to Unani medicine. All well-known Unani authors described colchicum for the treatment of arthritis as primordial drug in their books. It was clinically evaluated that colchicum equally used for the treatment of 3 important types of arthritis which are gouty arthritis, rheumatoid arthritis and osteoarthritis. It is demonstrated from study that Colchicum autumnale (commonly known as suranjan Shireen) has strong therapeutic potential against arthritis. In British pharmacopeia the Colchicum autumnale is used for the treatment of arthritis and gout. It is equal in effectiveness weather it is ingested orally or applied topically. It reduces inflammation and decrease pain in both situation

8.4.3 Anti-gout Activity

The extract of *Colchicum autumnale* was first described for the treatment of gout in the well-known book De Materia Medica. Colchicum was used first time for the treatment of gout in 5th century A.D by Jacob psychristus and in 6th A.D century colchicum was used as potent treatment for gout by Alexander of Tralles(Nuki & Simkin, 2006) . In Arabian writing the extract of this plant was also recommended for the treatment of gout. Colchicine alkaloid approved by FDA present in Colchicum autumnale used for the treatment of gouty arthritis in modern practice.

Akhtar and Husain (2019) conducted study in Aligarh during the time period 2015-2016 for the treatment of gout by using *Colchicum autumnale* (suranjan) in tablet form known as habb-e-suranjan. That was 18-months study consisting of randomized open trial and was carried out on 30 patients. The result of study demonstrated that Colchicum having excretory action on uric acid resulting in significant reduction of uric acid considered as primary treatment of gout. The colchicine present in colchicum inhibit the deposition of monosodium urate crystals, slow down the inflammatory mediators and kick out humor present around the joints.

8.4.4 Anti-Oxidant Activity

IOANA et al. (2017) investigated the anti-oxidant potential of Colchicum autumnale along with the detection of macronutrients such as carbohydrates and proteins and other secondary plants metabolites including terpenoids, flavonoids, tannins and polyphenols. The flower and root extract of plant separated by water and methanol was treated by using UV-VIS Spectroscopy, Fourier transformed IR spectroscopy and RAMAN spectroscopy to evaluate anti-oxidant activity.

Benedict and Millon reagents were used to determine the presence macronutrients including carbohydrates and proteins. The result of study revealed the presence of flavonoids, colchicine and polyphenols contributing to the anti-oxidant activity. And the presence of secondary plant metabolites was observed in the flower and root extract. Colchicum autumnale shows strong anti-oxidant potential at flowers = 52,81% than roots = 34,60 %. Biancamaria et al. (2020) investigated the biological activities of Colchicum autumnale. This study mainly focusses on the in vitro evaluation of anti-oxidant activity of Colchicum autumnale.

The results of this study were reported that due to alkaloid and phenolic composition Colchicum autumnale have potent anti-oxidant activity. Other pharmacological activities were also observed through this study. The anti-oxidant activity of this plant was observed against tyrosinase enzyme. Based on experimental study, At the same time moderate inhibitory potential of methanolic extract of Colchicum autumnale against alpha amylase and acetylcholinesterase enzymes was investigated. From study it was observed that extract have health promoting characterization and properties.

8.4.5 Anti-Cancer Activity

Colchicine is a water-soluble alkaloid found in pre-winter crocus that reduces or stifles cell division by preventing mitosis. In particular, the improvement in the nuclei's isolation waves is limited(Amin & Tahir,

2017).Periodically, the cell used its axial filaments to arrange its chromosomes, duplicate them, and separate them into two new cells, with each daughter cell having a separate arrangement of chromosomes. When colchicine is present, axial strands do not form, preventing the cell from moving its chromosomes. In all cases, the cell can replicate all or part of the chromosomes but cannot distribute itself into new cells and, therefore, never isolate itself. Since malignant cells isolate themselves much faster than normal cells, diseases cannot be further damaged by mitotic inhibitors such as colchicine, paclitaxel, vinca alkaloids, VCT, and VBL(Khlifi et al., 2013; Valizadeh & Zibaee, 2013).

Chapter - 8

Conclusion

Excessive level of heavy metals beyond permissible limit in therapeutic plants is a matter of concern regarding the public safety all over the globe. To solve this problem and make safety necessary it is highly important to detect the concentration of heavy metals in medicinal plants used for the treatment of various diseases. In this review, heavy metals and micronutrients from two medicinal plants *Apium graveolens* and *colchicum autumnale* discussed. It is interesting for further researches, including horticultural studies, for increasing safety by reducing of heavy metals contamination.

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