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Review Article

A review of the chemical constituents and pharmacological activities of *Antirrhinum majus* (snapdragon)

Gaurav Kumar[1,*]

[1] *Dept. of Pharmacology, Shri Ram College of Pharmacy, Muzaffarnagar, Uttar Pradesh, India*

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ABSTRACT

Antirrhinum majus (common snapdragon) is a flowering plant species in the Antirrhinum genus. It was traditionally used as a diuretic and to treat scurvy, liver problems, and tumours. The leaves and flowers were used to treat tumours and ulcers as antiphlogistic, resolvent, stimulant, and poultices. Amino acids, pigments, oils, anthocyanidins, flavonols, flavones, aurones, flavanones, cinnamic acids, and a variety of other compounds were found in *Antirrhinum majus. Antirrhinum majus* has antimicrobial, insecticidal, cytotoxic, antioxidant, central and peripheral nervous system effects, and many other biological activities, according to recent studies. The chemical constituents and biological effects of *Antirrhinum majus* are highlighted in this review.

1. Introduction

Traditional system is the drug systems which are used for many treatments of various diseases from ancient time to. Every country developed medicine according to their experience and knowledge. A wide range of secondary metabolite which are obtained from plant showed in current studies they are valuable in many purpose which we are used as a flavoring agent.[1] Colouring agent, pesticides, antiseptic, antifungal carcinogenic etc. A*ntirrhinum majus* (snapdragon) is belong the genus of antirrhinum and family scrophulariaceae which have contain many chemical compound like anthocyanides, flavones, aurones, amino acid , cinnamic acid, pigment and oil etc. According to current studies, the antirrhinum shows much pharmacological activity and used to cure many diseases.[2] Snapdragon is the flower which is having sensitive to ethylene and their half is to short. There are so many method which is increase their vase life of cut flower and his freshener for longer period of time, it should be preserve from detoriation and any foreign particle.[3]

Wide ranges of variety are available of snapdragon. height of the plant id 2-3 feet tall and the intermediate part of the plant is 1-2 feet tall, also the flower are Varity of colour like red, orange, yellow, green and maroon also in pale green and dark green in colour.[4] Garden snapdragons is the plant has been used for since many time for inheritance and gene control development in world there are 17-27 species of snapdragon flower are recognized with their different taxonomical characteristically A. majus species can fertile with each other species when cross pollinated occur artificially. There such hybrid are identified gene difference and colour between the parent in flower. A. mujus provide a model for understanding genetic pattern and phenotypic diversity.[5,6]

Artificial cross-pollination of A. majus. Natural Antirrhinum hybrids have also discovered genes involved in flower colour variation, and have proposed how selection acts on them, as have such hybrids identified genes underpinning changes in morphology and flower colour

* *Corresponding author*.
E-mail address: gktarapur@gmail.com (G. Kumar).

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between their parents. Antirrhinum can thus serve as a model for deciphering the genetic foundation for patterns of phenotypic variability and adaptation at the species level, which are likely to be seen in many recently evolved Mediterranean plants.

Fig. 1: Snapdragon flower

Table 1: Description

Kingdom	Plantae
Division	Tracheophyta.
Subdivision	Spermatophytina.
Class	Magnoliopsida
Superorder	Asteranae
Order	Lamiales.
Family	Scrophulariaceae Juss
Genus	Antirrhinum L.
Species	Majus.

2. Synonyms

Antirrhinum latifolium var. pseudomajus Rouy, Antirrhinum latifolium var. purpurascens Benth., Antirrhinum latifolium var. longipedunculatum Regel, *Antirrhinum majus* var. peloria Migout, *Antirrhinum majus* var. pseudomajus (Rouy) Rouy, *Antirrhinum majus* var Orontium majus Pers., Termontis racemosa Raf., Antirrhinum murale Salisb., Antirrhinum vulgare Bubani, Antirrhinum murale Salisb., Antirrhinum vulgare Bubani, Antirrhinum murale Salisb., Antirrhinum vulgare Bubani.[7,8]

2.1. Chemical constituent

It contains 2.79-5.69 percent free amino acids, 2.15-4.69 percent soluble sugars, and 0.22-0.27 percent carotenoids were found in *Antirrhinum majus*. The amino acids phenylalanine and tryptophan (each at a concentration of 50 or 100 ppm), whether used independently or in combination, enhanced free amino acids, soluble carbohydrates, and carotenoids.[9]

Fruit proanthocyanidins, flavonols, and anthocyanins were measured during fruit growth and ripening. Proanthocyanidins and total flavonol concentrations were highest in flower ovaries and early fruit development stages. Proanthocyanidins decreased rapidly during ovary development and growth, then increased slightly during fruit ripening. Flavonols showed a less pronounced decline from levels in flowers and early fruit set stages, and they also increased slightly during fruit ripening. The major flavonol glycosides were quercetin-3-galactoside, quercetin-3-arabinofuranoside, quercetin-3-rhamnoside, quercetin-3-(6′′-benzoyl)—galactoside, methoxyquercetin pentoside, and quercetin-3-(6′′-coumaroyl). -β-galactoside.[10]

Anthocyanidins, flavonols, flavones, aurones, flavanones, and cinnamic acids were found in *Antirrhinum majus*. Flavone, flavonol, aurone, and anthocyanin glycosides were discovered in *Antirrhinum majus* colour types by Geissman et al. The aurone pigment is only found in flower petals; the other pigments can be found in flowers, stems, and leaves. Harborne, on the other hand, isolated five flavones from *Antirrhinum majus* flowers, namely apigenin 7,4′-diglucuronide, luteolin 7-glucuronide, chrysoeriol 7-glucuronide, kampferol 3-glucoside, and kampferol 3,7-diglucoside. Bracteatin 6-glucoside, a new aurone, was also isolated.[11–13]

Monoterpenes were abundant in *Antirrhinum majus*.[10,14] Three chalcones were discovered in A. majus yellow flowers, two of which were identified as chalcononaringenin 4′-glucoside and 3,4,2′,4′,6′-pentahydroxychalcone 4′-glucoside.[15] Total iridoids in *Antirrhinum majus* showed significant seasonal variation. The total iridoid content ranged from 9.16 to 107.98 mg/g dry weight. The amounts of Antirrhinoside, Antirrhide, 5-Glc-antirrhinoside, and Linarioside also varied. Their percentages were (69.87-93.33 percent), (2.57-19.84 percent), (1.61-14.19 percent), and (0.00-2.97 percent), respectively.[16]

The content of the four iridoids (antirrhinoside, antirrhide, 5-glucosyl-antirrhinoside, and linarioside) found in *Antirrhinum majus* cultivars varied seasonally and diurnally. The seasonal variation in total iridoid content revealed a distinct bimodal distribution, with high total values (around 100mg/g dry matter) early and late in the season, and a very low total iridoid content coinciding with the onset of flowering at the beginning of August. Antirrhinoside contribution was significantly higher before flowering than after bud break. The diurnal variation ranged from 20 to 60mg/g dry weight, but there was no relationship to light/darkness conditions, temperature patterns, or water content.

Snapdragon blooms have a relatively simple floral smell made up of volatile chemical components (VOCs). Myrcene, (E)-beta-ocimene, and methyl benzoate were the three primary snapdragon floral volatiles.[17]

1-Methoxybutane, 3-Methylcyclohexanone, 1-Methoxybutane, 1-Methoxybutane, 1-Methoxybutane, 1-Methoxybutane, 1-Methoxybutane, 1-Methoxybutane, 1-Methoxybutane, 1-Methoxybutane, 1- 4-Methylnonane, 4-Methylnonane, 4-Methylnonane, 4- (E,E)-3,8-dimethylundecane Henedecane, trans-p-Mentha-2,8-dien-1-ol, 5-octadien-2-one Carvomenthone, trans-1,3, cis-1,4-Menthol, 4-Methyldecane, 2-Ethylhexanoic acid Ethyl undecanoate, Eicosane, Octadecanioc acid ethyl ester, Hexadecanioc acid methyl ester, and Protoverine.[18] 6-isopropyl-3-methylcyclohexen-2-one, Ethyl undecanoate, Eicosane, Octadecanioc acid ethyl ester, Hexadecanioc acid methyl

3. Pharmacological Activity

3.1. Antioxidant effect

The radical scavenging activity (RSA) of A. majus oil against 1,1-diphenyl-2-picrylhydrazyl (DPPH) radicals and galvinoxyl radicals was higher than that of extra virgin olive oil.[19] Absolute methanol extract and its fractions from the snapdragon (*Antirrhinum majus*) plant were tested for antioxidant activity. The presence of total phenolics, IC50, and percent inhibition in linoleic acid oxidation were all assessed. Sunflower oil was used as an oxidative substrate to study the antioxidant activity of plant extracts and fractions. By stabilising the sunflower oil as an oxidation substrate, the peroxide value (PV), free fatty acids (FFA), conjugated dienes (Cd), conjugated trienes (CT), and para-anisidine values were all determined. Furthermore, it was found to protect plasmid pBR322 DNA from H2O2-induced oxidative damage, indicating that the plant has antioxidant properties. As a result, the authors discovered that the snapdragon plant may be a good source of natural antioxidants.[18]

3.2. Effect on central and peripheral nervous system

Aurones, flavonoids that are structurally isomers of flavones, were synthesised in *Antirrhinum majus*.[20,21] They were given the chemical name benzylidenebenzofuran-3(2H)-ones. Aurones and extracts containing them were effective in the prophylactic and/or therapeutic treatment of an animal (including humans) suffering from a phosphodiesterase (PDE) dependent disease or condition of the central nervous system. Neurodegenerative disorders such as Parkinson's disease, Alzheimer's disease, age-related dementia or dementia in general, neurological trauma including brain or central nervous system trauma, depression, anxiety, psychosis, cognitive dysfunction, mental dysfuntion, learning and memory disorders, and ischemia of the central and/or peripheral nervous systems are among the nervous system diseases and conditions to be treated prophylactically or therapeutically.[10]

3.3. Antimicrobial effect

The antimicrobial activity of various concentrations of plant extract and fractions against selected microorganisms was investigated. The results showed that as the concentration of plant extract and fraction increased, so did the antimicrobial activity. The plant samples exhibited significant antimicrobial activity against the majority of the bacterial and fungal strains tested. The disc diffusion method revealed that absolute methanol extract has significant inhibitory activity at a concentration of 10 mg/mL against bacterial strains such as S. aureus (IZ = 33.60 mm), B. subtilis (IZ 31.40 mm), P. multocida (IZ 29.40 mm), E. coli (IZ 30.50 mm), and against fungal strains R. solani (IZ 31.10 mm), A. niger (IZ 30.30 (IZ 25.30). The extract of n-hexane the findings revealed that increasing the concentration of plant extract and fraction. The n-hexane extract (extracted by soxhlet) demonstrated less activity against all bacterial and fungal strains tested. It was discovered that when the concentration of plant extract and fraction was increased to 5 mg/ml, some of the strains that were resistant at 1 mg/ml were also inhibited. The n-butanol fraction had no effect on E. coli growth. S. aureus, B. subtilis, A. alternata, and A. niger were also unaffected by the chloroform fraction. In comparison to the other fractions, the ethyl acetate fraction demonstrated significant activity.[22]

3.4. Anticancer effect

The study was confirm the phytochemical richness, we first determined the content of major phytochemical classes in SFE used in our study, such as polyphenols, flavonoids, proanthocyanidins, and carotenoids. Polyphenols are a large class of compounds that contain multiple phenol units and are widely distributed in higher plants. Flavonoids have two phenyl and one heterocyclic ring structure, which makes them polyphenols. Proanthocyanidins are a type of flavonoid that comes in oligomeric form. Carotenoids are a group of pigments found in nature that are structurally defined by the presence of tetraterpenoids with eight isoprenes. These phytochemical classes are abundant in plants, and their wide ranges of health benefits, including cancer-fighting properties, have been extensively researched[23].

3.5. Genome structure and evolution

A majus genome sequencing, assembly, and annotationUsing a combination of Illumina short-read and PacBio long-read sequencing technologies, we sequenced a highly inbred Antirrhinum line (A. majus cv. JI7). The genome size was estimated to be around 520 Mb based on k-mer distributions. We were able to obtain 90.85 GB of high-quality Illumina paired-end reads, which is equivalent to 174-fold sequence coverage of the genome. CANU19 was used to correct and assemble 25.89 Gb PacBio reads into contigs, while SSPACE20 was used to scaffold Mate-paired short reads. The assembled genome was 510 Mb in size, with contig and scaffold N50 (the size above which 50% of the total length of the sequence assembly can be found) sizes of 0.73 and 2.6 Mb, respectively The coverage of contigs using PacBio data was 99.97 percent, and the mapping ratio of 42.22 Illumina data was 99.55 percent (Supplementary Table 5). Using Illumina sequencing data, the assembled genome's heterozygosity was estimated to be 51 single nucleotide polymorphisms (SNPs) per 1 Mb (0.0051 percent).

Duplicated and triplicated regions between and within chromosomes were discovered using self-alignment analysis. There were 45 major duplications and two triplications discovered among the eight Antirrhinum chromosomes, totaling 1,841 pairs of paralogous genes (Figure 1 and Supplementary Data Set 5). We used all-against-all comparisons to find 2,115 Antirrhinum single-copy genes with orthologues in nine angiosperm species (A. majus, Arabidopsis thaliana, Amborella trichopoda, Carica papaya, Oryza sativa, Petunia hybrida, Prunus mume, Solanium lycopersicum, Symphytum tuberosum and Vitis vinifera). The phylogenetic tree that resulted shows that the Antirrhinum lineage split from the potato and tomato lineages around 62 Ma, which is consistent with the findings[24].

4. Conclusion

Antirrhinum majus (common snapdragon) contained a variety of chemical constituents such as amino acids, pigments, oils, anthocyanidins, flavonols, flavones, aurones, flavanones, cinnamic acids, and others. Recent research has revealed that *Antirrhinum majus* has a wide range of pharmacological activities, including antimicrobial, insecticidal, cytotoxic, antioxidant, genome evolution, central and peripheral nervous system effects, and a variety of other biological activities. The chemical constituents and biological effects of *Antirrhinum majus* are highlighted in this review.

5. Conflict of Interest

The authors declare no relevant conflicts of interest.

6. Source of Funding

None.

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Author biography

Gaurav Kumar, Assistant Professor

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