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A Review on Heliotropism Plant: *Helianthus annuus* L.

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Abstract

Nowadays, plants are used as medicinal hub for the various disease treatments and as cosmeceuticals. *Helianthus annuus* L. is the source of various chemical constituents which are used for the treatment of many fatal or life threatening diseases. It is one of the best plants for the antimicrobial activity. The leaves of this plant are source of maximum photochemical then other parts like seeds, stem, flower etc. This review is a pharmaceutical and medicinal update on *Helianthus annuus* L.

Keywords: Heliotropism, Sun Flower, Nevadensin.

Introduction

From the ancient time, plants are the main source of treatment and nowadays they are hub of medicinal source not only in developing countries, but also in developed countries where modern medicines are predominantly used. In the Indian system of medicines, most practitioners formulate and dispense their own recipes; hence this requires documentation and maintenance. In western countries the use of herbal medicines is steadily growing. To be accepted as viable alternative to modern medicine, the same vigorous method of scientific and clinical validation must be applied to prove the safety and effectiveness of a therapeutic product.[1-3]

Sunflower having biological name *Helianthus annuus* L. is cultivated primarily for its seeds, which yield the world's second most important source of edible oil. The seed oil, shoots, and herb tincture have been employed for anti-inflammatory, antipyretic, astringent, cathartic, diuretic, emollient, expectorant, stimulant, vermifuge, and vulnerary purposes. Prior to the use of the seeds as a food, other parts of the plant, notably the petioles and young flowers, were used as savory delicacies. The use of yellow petals as coloring agents gives its new prospective in cosmetic industry.[4-6]

Taxonomical Classification

Kingdom: Plantae
Division: Angiospermae
Subdivision: Eudicots
Class: Asterids
Order: Asterales
Family: Asteraceae
Subfamily: Helianthoideae.[7]

Synonyms

Chrysanthemum peruvianum,
Helianthus annuus subsp. jaegeri,
Helianthus annuus var. lenticularis,
Helianthus annuus var. macrocarpus,
Helianthus annuus var. texanus,
Helianthus aridus,
Helianthus lenticularis.[8]

Botanical Description

Helianthus annuus L. is a coarse, stout and erect annual plant, up to 1-3 meters high.
Roots: Seedling initially tap rooted, with maturing plants developing a large fibrous, lateral root spread.
Stems: Stems 1-6.5 ft. (30-200 cm) tall, hispid, round, branched. Herbage rough-hispid.
Branching: Simple to highly branched, each terminating with a composite head (capitulum). Cultivated types are mostly single-headed plants.
Leaves: Lowermost leaves mostly opposite along stem, upper leaves mostly alternate along stem. Leaf blades narrowly to usually broadly deltoid-ovate, lower ones often cordate, to sub-truncate to broadly cuneate at base, 1.5-8 in. (4-20 cm) long or more, 1.2-6 in. (3-15 cm) wide or more, entire to margins minutely to coarsely serrate, apex acute to abruptly auminate.
Inflorescence: Large, composite heads, solitary at terminal end of peduncle or terminal on a branch, or axillary; composite disk usually 0.8-3.2 in. (2-8 cm) wide or more including rays; peduncles 0.8-8 in. (2-20 cm) long, densely hispid-scabrous. Receptacle low-convex, chaffy. Heads few to many.
Flowers: Ray flowers sterile, 0.6-1.6 in. (1.5-4 cm) long, ligules yellow. Disc flowers perfect, corolla lobes 5, 0.2-0.3 in. (5-8 mm) long, tubular, purple-brown to yellow; each floret subtended by a small firm, paleaceous bract attached to the receptacle, often 3- toothed. Pappus 2 readily deciduous, awn-like palea floret subtended by a small firm, paleaceous 0.08-0.1 in. (2-3.5 mm) long,
Gynoecium: Disc flowers, ovary inferior.
Fruit: Achenes 0.1-0.3 in. (3-6 mm) long or more, narrowly obovate to ovate, more or less 4 angled, somewhat compressed, glabrous to minutely puberulent especially at apex, gray to brown and occasionally mottled to striped.[9-11]

Climate Effect

Helianthus annuus L. plants are intolerant of shade. It tolerates an annual mean temperature range of 43-82°F (6-28°C). Mature *Helianthus annuus* L. plants can tolerate minimum temperatures to 28.4°F (-2°C). *Helianthus annuus* L. seedlings are less sensitive to freezing temperatures than mature plants.[11]

Heliotropism is a miracle or misconception?

Solar tracking in the common sunflower, *Helianthus annuus* L., is a dramatic example of a diurnal rhythm in plants. During the day, the shoot apex continuously reorients, following the sun's relative position so that the developing heads track from east to west. At night, the reverse happens, and the heads return and face east in anticipation of dawn. This daily cycle dampens and eventually stops at anthesis, after which the sunflower head maintains an easterly orientation. In fact, mature flower heads typically face east and do not moves. The leaves and buds of young of *Helianthus annuus* L. do exhibit heliotropism. Their orientation changes from east to west during the course of a day. The movements become a circadian response and when plants are rotated 180 degrees, the old response pattern is still followed for a few days, with leaf orientation changing from west to east instead. The leaf and flower head bud phototropism occurs while the leaf petioles and stems are still actively growing, but once mature, the movements stop. These movements involve the petioles bending or twisting during the day then unbending or untwisting at night.[12-14]

Figure 1: Flower of *Helianthus annuus* L.

Figure 2: Seeds of *Helianthus annuus* L.

Figure 3: Leaves of *Helianthus annuus* L.

Traditional Uses

In a review, Saini *et al.* (2011) described the traditional uses of *Helianthus annuus* L. like food and source of different disease treatment. It is utilized for several treatments like speedy recovery of wounds, treatment of the kidney diseases, for treating chest pains and pulmonary troubles, to alleviate rheumatism and treatment of asthma. It is also used worldwide as a lubricant, stimulant, anti-diarrheal, as dermatological aid and as a disinfectant. Apart from this, tea and other preparation made from different parts of plant is used in the treatment of high fevers, as a poultice on sores, swellings, snakebites and spider bites, in the treatment of malaria, lung ailments, diabetes.[7]

Phytochemistry and Chemical Constituents

Subashini *et al*. (2012) evaluated the methanolic extract seeds of *Helianthus annuus* L. for the photochemical present in the plant and results shows that the carbohydrates, flavanoids, tannins, alkaloids, saponins, phytosterols, steroids and fixed oils were present and starch, glycoside and proteins were absent in the extract.[15]

Kamal *et al.* (2011) determined the allelochemicals in leaves, stems and roots of sunflower using thin layer chromatography for alkaloids and spectrophotometry for phenols and flavonoids. The content of allelochemicals was highest in the leaves, followed by the roots and stems, respectively. Stress stimulates the production of allelochemicals.[16]

Macias *et al*. (2008) isolated an ent-kaurane glycoside named helikauranoside A from the aerial parts of *Helianthus annuus* L. together with three known ent-kaurane-type diterpenoids: (−)-kaur-16-en-19-oic acid, grandifloric acid, and paniculoside IV.[17]

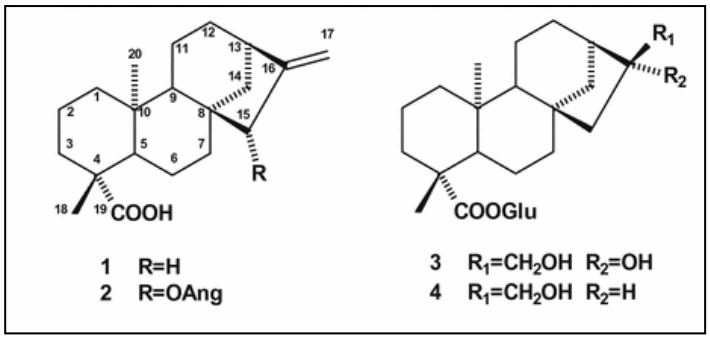
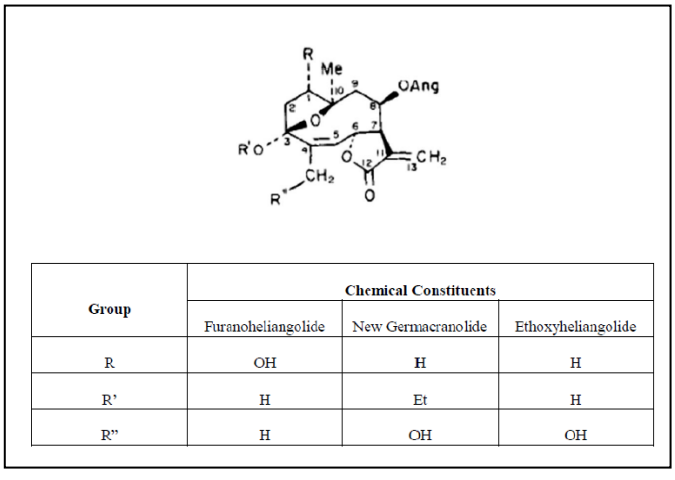


Figure 4: Chemical Structure of 1). (−)-kaur-16-en-19-oic acid 2). Grandifloric acid 3). Paniculoside IV and 4). Helikauranoside A

From the ethanolic extract a new germacranolide with a-methylene-y-lactone moiety, the heliangolide niveusin B and its ethoxy derivative were isolated and their structures elucidated by spectroscopic methods and two sesquiterpene are also isolated from the leaves and stem. Both sesquiterpene lactones (SL) strongly inhibit indole-3-acetic acid (IAA)-induced elongation growth.(Spring et al. 1982A & 1982B).[18,19]



Group	Chemical Constituents		
	Furanoheliangolide	New Germacranolide	Ethoxyheliangolide
R	OH	H	H
R'	H	Et	H
R"	H	OH	OH

Figure 5: Heliangolides Derivatives

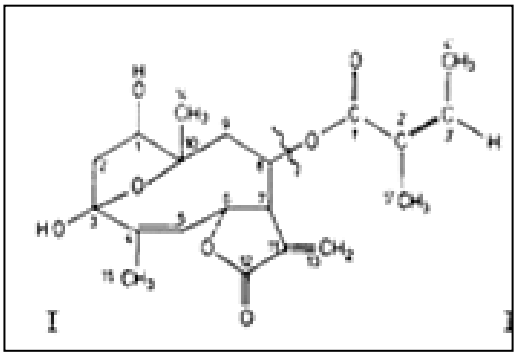


Figure 6: Chemical Structure of Niveusin C

Caffeic acid, clorogenic acid and dicaffeoylquinic acid are also isolated from aqueous methanol extract of seeds of sunflower. Disubstituted cinnamic acid and monoester of quinic acid are some phenolic content which are isolated from the plant of sunflower by Mikolajczak (1970).[20]

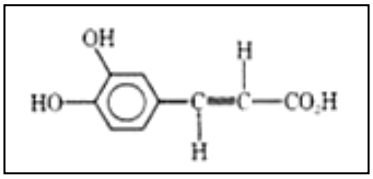


Figure 7: Chemical structure caffeic acid

Four tocopherol (α,β,γ and δ) isomers are also available in sunflower seed oil bodies.[21] Some light colored proteins are also isolated by Pickardt (2011).[22] It contains helianthinin as globulin.[23]

The flavonol tambulin, the chalcones kukulcanin B and heliannone A and the flavanones heliannones B and C are five flavanoids which are isolated from *Helianthus annuus* L. by Macias (1997) and Rao (2001).[24,25]

Nevadensin, a bioflavonoid exhibited a wide range of significant biological activities including hypotensive, anti-tubercular, antimicrobial, anti-inflammatory, anti-tumour and anti-cancer activities can also be isolated from *Helianthus annuus* L.[26]

Suo et al. (2014) isolated four compounds namely (2R)-2-hydroxy-N-[(2S,3S,4R,10E)-1,3,4-trihydroxyicos-10-en-2-yl]docosanamide, (2R,3R)-2,3-dihydroxy-N-[(2S,3S,4R,10E)-1,3,4-trihydroxyicos-10-en-2-yl]docosanamide, N-(2-phenylethyl)tetracosanamide, together with a known ceramide, (2R)-N-[(2S,3S,4R,8E)-1-(β-d-Glucopyranosyloxy)-3,4-dihydroxyoctadec-8-en-2-yl]-2-hydroxyhexadecanamide from acetone extract of flower disc of *Helianthus annuus* L.[27]

Glenn *et al*. (1987) isolated a proteinaceous competitive inhibitor of lipase from the seeds of *Helianthus annuus* L.[28] A 16-kDa protein, SAP16 is also isolated by Giudici (2000).[29]

Pharmacological activities of *Helianthus annuus* L.

Various research works had been done by researchers to investigate the biological or pharmacological activities associated with *Helianthus annuus* L.

Macias *et al*. (2007) isolated six triterpene glycosides from an n-Butanol-soluble fraction of a methanol extract of the ligulate flower petals of sunflower which possess marked anti-inflammatory activities on 12-O-tetradecanoylphorbol-13-acetate induced ear edema in mice. All of the triterpene glycosides tested showed potent inhibitory effects and are more potently inhibitory than indomethacin. Among them, helianthoside B exhibited a strong inhibitory effect that was almost the same order of potency as that of hydrocortisone.[17]

As we know molecular inflammation is associated with various degenerative immune diseases, including asthma and atopic dermatitis. In a study, Heo *et al*. (2008) examined the effects of *Helianthus annuus* L. seed aqueous extract on an in vivo anti-asthmatic model on ovalbumin induced mice and their lungs were assessed by hematoxylin and eosin staining. These findings collectively suggests that the extract has considerable potential in reducing the asthma.[30]

Giada *et al*. (2009) evaluated the antioxidant capacity of the striped sunflower seed cotyledon extracts obtained by sequential extraction with different polarities of solvents by three different in vitro methods: ferric reducing/antioxidant power, 2.2-diphenyl-1-picrylhydrazyl radical and oxygen radical absorbance capacity assays. In the three methods, the aqueous extract with a dose 30 µg/ml showed a higher antioxidant capacity value than the ethanolic extract. When compared with the synthetic antioxidant butylated hydroxyl toluene, the antioxidant capacity of the aqueous extract varied from 45% to 66%, according to the used method. The high antioxidant capacity observed for the aqueous extract of the studied sunflower seed suggests that the intake of this seed may prevent cancer and other oxidative reaction related diseases.[31]

Ukiya *et al*. (2003) isolated eight fatty acid esters of triterpene alcohols, four free triterpene alcohols, four

diterpene acids, two tocopherol-related compounds, four estolides, three syn-alkane-4,6-diols, one 1,3-dioxoalkanoic acid, and one aliphatic ketone, along with the mixture of free fatty acids from the diethyl ether extract of the pollen grains of *Helianthus annuus* L. Among the 30 compounds tested, 21 compounds showed potent inhibitory effects on Epstein-Barr virus early antigen induced by the tumor promoter induction.[32]

Abushama *et al*. (2014) recently at Sudan National Research Center investigated the antitumor and antioxidant activity of fixed oil of Sudanese medicinal plants including *Helianthus annuus* L. Antioxidant activity results of the five fixed oils measured using DPPH and fixed oil of *Helianthus annuus* L. showed moderate antioxidant activity. Fixed oil of this plant showed no activity when using Iron Chelating Assay.[33]

Sen *et al.* (2001) extracted the protein fraction enzymatically from seeds and investigated for its dietary effect on the growth, plasma and tissue lipid profiles, plasma protein content, erythrocyte membrane lipid profile and organ weights of rats. The results demonstrated the hypolipidemic action of protein fraction and that it can be considered a suitable edible protein like casein.[34]

Subashini *et al.* (2012) evaluated the antioxidant and antimicrobial activity of methanolic extract of seeds from *Helianthus annuus* L. On the basis of results of antibacterial activity analysis, the seed extract showed high sensitivity to Salmonella typhi, moderate sensitivity to Staphyllococcus aureus and Vibrio cholera and less sensitivity to Bacillus subtilis and for antifungal activity, the extract of *Helianthus annuus* L. showed high sensitivity to Rhizopus stolonifer and Aspergillus fumigates, moderate sensitivity to Candida albicans and resistant to Fusarium oxysporum. This plant is also evaluated for the antioxidant and that study also gives significant results.[15] A 16-kDa protein was also isolated by its ability to inhibit the germination of fungal spores by a clear reduction of mycelial growth at lower concentrations, indicating a strong antifungal potency against natural pathogen.[29] Some research work to evaluate anti bacterial activity of sunflower is also performed by preparing it's nanoparticles which also gives potent results.[35]

Its oil is also effective in some disease or physiological changes such as; block thrombosis at sites of vascular injury, inhibit pathologic platelet vascular interactions associated with atherosclerosis, maintenance of the immune response and improves mood by serotonin production.[36]

Conclusion

The sunflower is the hub of medicinal values which is used as food and medicine worldwide. *Helianthus annuus* L. is mostly famous for Heliotropism which means flower of this plant moves towards the direction of sun, called sun tracking. Several researchers work on this and conclude this as misconception. It has various alkaloid, flavonoids, volatile oils and terpenoids essential for various activities like antimicrobial activity, antitumor activity, anti oxidant activity etc. It may direct the further research on sunflower for some activities for which it is used traditionally.

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