

Review Article

Chemistry, Pharmacology and Ethnomedicinal Uses of *Helianthus annuus* (Sunflower): A Review

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Abstract

Helianthus annuus commonly known as “Sunflower” is a well-known plant in India and Pakistan. It is native to North America. It is use in ethnomedicine for treating a number of disease conditions which include heart disease, bronchial, laryngeal and pulmonary affections, coughs and colds and in whooping cough. *Helianthus annuus* contains various bioactive compounds which include phenol, terpene compounds, carbohydrates, flavanoids, tannins, alkaloids, saponins, steroids, fixed oil and active proteins all of these contribute to its remedial properties. *H. annuus* is pharmacologically studied for various activities including ganti-inflammatory, anti-oxidant, antitumor, antiasthmatic, antigen, antipyretic, astringent, antihypoglycemic effect, antifungal activities, cathartic, diuretic, stimulant, vermifuge, vulneray purposes and antimicrobial activities. The analysis of the phytochemical constituents, uses and pharmacological properties of *H. annuus* was carried out by using different sources such as medicinal plant databases, ethnobotanical and ethnopharmacological books and different published papers. This review presents a reasonable study of the chemical; nutritional and pharmacological properties of *H. annuus*.

Keywords: *Helianthus annuus*; Chemistry; Nutritional value; Medicinal uses

Introduction

From the ancient time, plants are the main source of treatment and nowadays they are focal point of medicinal source not only in developing countries, but also in developed countries where modern medicines are predominantly used. It is analyze that till to now 75-90 % of the world population depends on plants and plants extracts which act as a primary source of health care [1]. This wide spread use of

plant extracts in treatment of diseases lead to increase an interest in the identification of active compounds which give the extracts their curative potential. The Sunflower (**Fig. 1**) is a native of North America [2]. The sunflower is the core of medicinal values which is used as food and medicine worldwide. *H. annuus* is cultivated basically for its seeds, which give the world's second most important source of edible oil. The seed oil, shoots, and herb tincture is

employing for anti-inflammatory, anti-oxidant, antitumor, antiasthmatic, antigen, antipyretic, astringent, antihypoglycemic effect, cathartic, diuretic, stimulant, vermifuge, antimicrobial activities and vulnerary purposes, other parts of the plant, the petioles and young flowers are use as savory delicacies. The use of yellow petals as coloring agents gives its new eventual in cosmetic industry [3].

Taxonomy

Taxonomy of *H. annuus* is as kingdom: plantae, Division: angiospermae, Subdivision: eudicots, Class: asteroids, Order: Asterales, Family: Asteraceae, Subfamily: Helianthoideae, Scientific Name: *Helianthus annuus* L. [3].

Botanical description:

Helianthus annuus L. is a stiff, plump and common annual plant 1-3 meters high. It has initially tap roots but when plant become mature then develops large, fibrous and lateral roots. Stems of this plant are 1-6ft tall, hispid, round and unbranched. Stem length is determined by the number of internodes. Leaves are arranged in such a way that lowers leaves mostly opposite along stem and upper leaves alternate along stem. Leaves are mostly ovate shaped and mostly 4-20cm long and 3-15cm wide or more, apex acute to abruptly acuminate and margins are serrate. Inflorescence of this plant is a capitulum composite heads, solitary at terminal of peduncle or terminal on a branch or axillary, ray and disc florets present. Ray flowers are sterile, 0.6-1.6 inch long, ligules yellow. Disc flowers perfect, corolla lobes 5, 0.2-0.3 inch long, tubular and purple brown to yellow. Pappus is 2 and deciduous and ovary is inferior in disc flower. Fruit of *H. annuus* is an achene. Achenes vary from 7 to 25mm in length and 14 to 13 mm in width [4].

The head of sunflower is made up of 1,000 to 2,000 individual flowers which are connected at a common receptacle. It has ray

flowers which are ligulated around boundary and are without stamens and pistils and the other flowers are perfect. Anthesis initiates at the periphery and move toward head. In temperate regions sunflower require about 11 days from planting to emergence, 33 days require from emergence to head formation, 27 days from head to first anther formation and 8 days from first to last anther for maturity from last anther to crop 30 days need. Varieties differences occur in maturity occur due to changes in vegetative period before the head become able to seen [5].

Nutritional Benefits

Sunflower seed mainly grown for oil is a source of vegetable proteins [6]. The different health advantages of sunflower seeds credited to the high levels of polyunsaturated and monounsaturated fats, phytosterols, tocopherols, protein, copper, folates, iron, zinc and vitamin B. Sunflower oil contains four important fatty acids which are palmitic, stearic, oleic, and linoleic [7-9]. Sunflower oil is basically triglycerides (fats), commonly derived from the fatty acids linoleic acid and oleic acid. Different constituents of sunflower oil are lecithin, tocopherols, carotenoids and waxes. This oil is light in taste and colour and has high vitamin E content. It is a mixture of monosaturated and polysaturated fats with little saturated fat levels [10].

Chemistry

H. annuus contains different biologically active compounds (Table 1) that exhibit physiological effects which can be responsible for its curative potential in a broad range of disease conditions. These non-nutritive chemicals are known as phytochemicals and are naturally produced by the plant as defense against biotic and abiotic stresses. Most researchers used standard methods for screening of phytochemicals in *H. annuus*. Allelochemicals found in leaves, stems and roots of *H. annuus*. The important chemicals

derived from *H. annuus* are flavonoids, flavanoids, carbohydrates, tannins, saponins, alkaloids, phytosterols, active proteins and fixed oils [11]. The composition of the seed of sunflower is as proteins, peptides, amino acids and other non-protein nitrogen, carbohydrates, lipids, fatty acids, palmitic acid, olic acid, linoleic acid, tochopherol, carotenoids, vitamin, chlorogenic acid, quinic acid, caffeic acid, total minerals potassium, sulphur, phosphorus, calcium, magnesium and sodium [12].

Carbohydrate

Polysaccharides which are non-starch obtained from sunflower (*H. annuus* L.) extracts by delignification of the related cell wall materials which were sub fractionated by graded ethanol precipitation, adsorption chromatography and size exclusion and by chronological alkaline extraction [13]. The methanolic seeds extract of *H. annuus* L. show that the plant contain significant amount of carbohydrates [14].

Tannins

Tannins are reported in *H. annuus* and it is analyzed that contain an oleic acid, alkaloid, tannins, fixed oils and simple phenolic compound [15].

Phenols

Phenols are isolated from *H. annuus* Florets of sunflower are rich source of dietary fiber, Fe and phenols [16].

Terpene compounds

From the aerial parts of *H. annuus* an ent-kaurane glycoside named helikauranoside A (Fig. 2) are analyze along three known compounds which are grandifloriacid, paniculoside and ent-kaurane-type diterpenoids: (-) kaur-16-en-19-oic acid [17]. A new germacranolide with α -methylene- γ -lactone moiety, the heliangolideniveusin B and its ethoxy derivative (Fig3) are isolated by ethanolic extract and their structures elucidated by spectroscopic methods and two

sesquiterpene are derived from the leaves and stem [18, 19].

Allelochemicals

Allelochemicals are analyzed in leaves, roots and stems of sunflower by using thin layer chromatography for alkaloids and spectrophotometry for flavonoids and phenols [20].

Flavonoids

Five flavanoids (Fig 4) which include chalconeskukulcanin B, helianone A, the flavanones heliannones B and C and flavonoltambulin are isolate from *H. annuus* L. [21, 22].

Proteins

Some light colored proteins are derived from *H. annuus*. Four tochopherols (α , β , γ and δ) isomers are also present in sunflower seed oil bodies. It contains helianthinin as globulin [23].

A proteinaceous competitive inhibitor of lipase is isolated from the seeds of *H. annuus* L. [24]. A 16-kDa protein, SAP16 is also isolated [25].

Sunflower oil

Sunflower seeds contain high amount of vitamin E rich oil. This oil is very beneficial for human due to high amount of vitamin E and low amounts of saturated fat. The most active component of this oil is α -tocopherol which is an antioxidant that protect against ROS (Reactive oxygen species). This oil is largely utilized by food industry. This oil can withstand at high cooking temperature. Sunflower oil is use as a lubricant and cosmetic ingredient. It is also used as a vegetable oil [26].

Caffeic acid, chlorogenic acid and dicaffeoylquinic acid

Caffeic acid (Fig. 5), chlorogenic acid and dicaffeoylquinic acid are isolated from aqueous methanol extract of seeds of sunflower [11].



Figure 1: *Helianthus annuus* Flower (a), Leaves (b) and seeds (c)

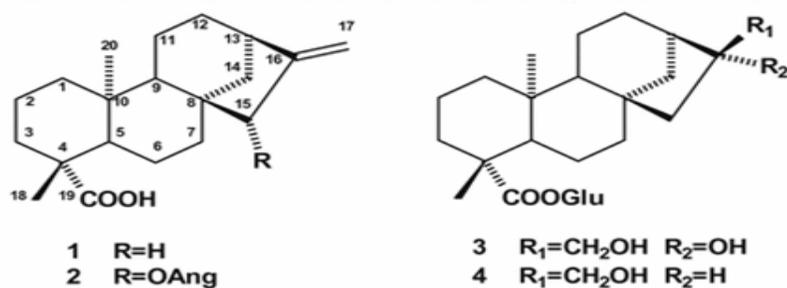


Figure 2: Chemical Structure of 1). (-)-kaur -16-en-19-oic acid 2). Grandifloric acid 3). Paniculose IV and 4). Helikauranoside A (Dwivedi and sharma, 2014).

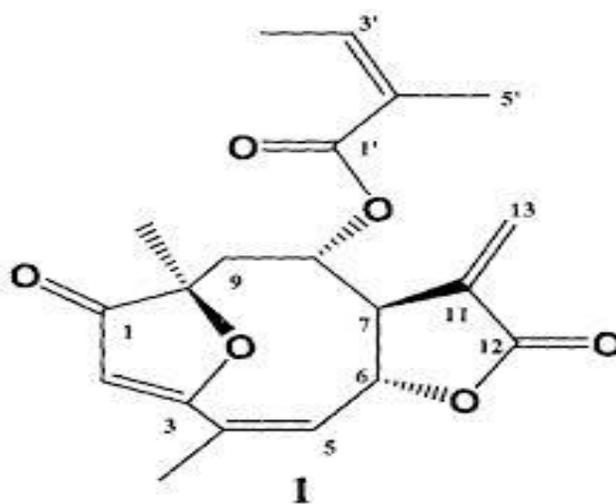


Figure 3: Heliangolide derivatives

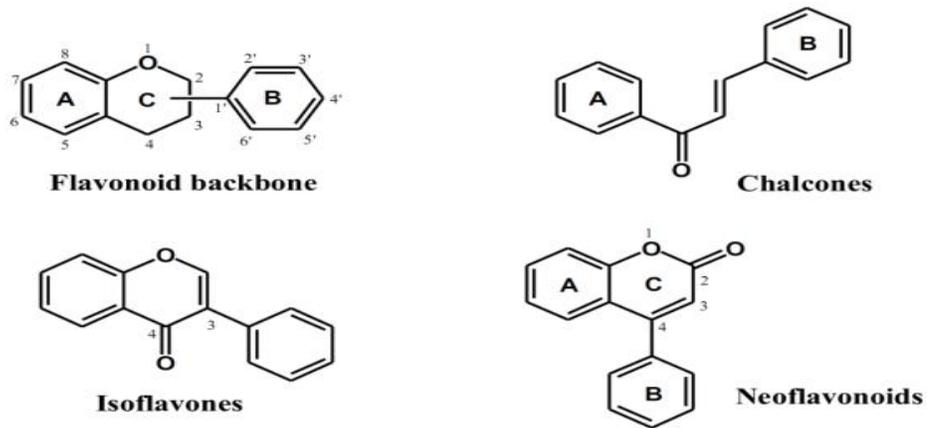


Figure 4: Chemical structures of Flavonoids

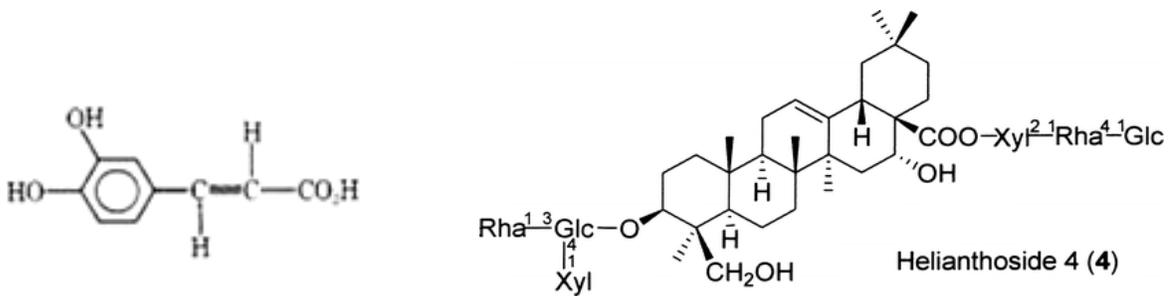


Figure 5: Caffeic acid [11]

Figure 6: Helianthosides 4(4) [31]

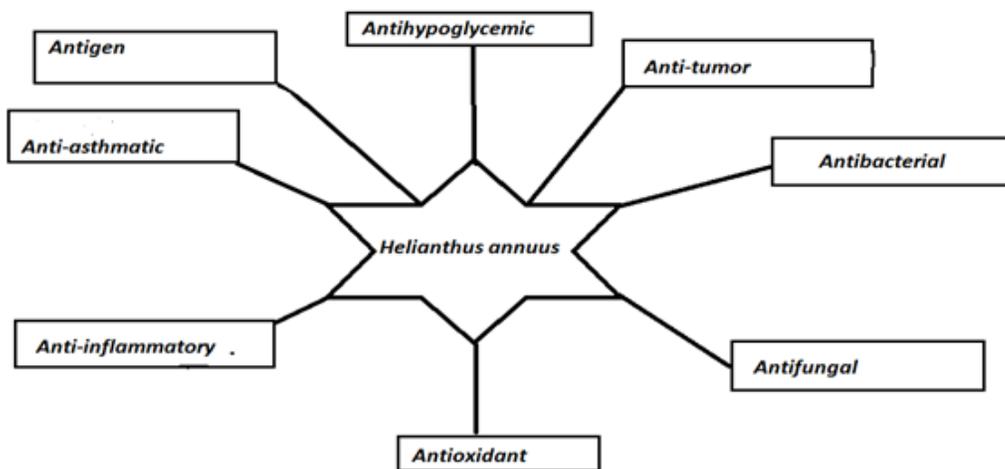


Figure 7: Pharmacological activities of *Helianthus annuus*

Table-1. Phytochemicals found in *Helianthus annuus*.

Name of compounds	Plant part	References
Alkaloids	Seeds	[35]
Carbohydrates	Seeds	[13]
Phenolic compound	Florets	[16]
Allelochemicals	Leaves, Stems, Roots	[20]
Saponin	Seeds	[35]
Tannins	Seeds	[15]
Terpenoids	Aerial parts	[17]
Steroids	Seeds	[35]
Flavonoids	Seeds	[22]

Table-2. Some Traditional uses of *Helianthus annuus*.

Traditional use	Plant part	Country	References
Cuts , Wounds	Stem	Cochiti(New Mexico)	[30]
Kidneys treatment	Leaves	America	[30]
Fever	Leaves	Russia	[10]
Pulmonary infections	Seeds	Europe	[30]
Bronchiectasis	Flowers and leaves	India	[10]

Other compounds

It is indicated that from acetone extract of flower disc of *Helianthus annuus* L. four compounds namely (2R)-2- hydroxyl-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 are derived [27].

Ethnomedicinal Uses

Sunflower plant is a medicinal plant. Different parts of plant are traditionally use for treatment of different ailments. A review of books and papers shows that *H. annuus* is used in local medicine in some Asian and European countries. The *H. annuus* seeds are use in the treatment of laryngeal, pulmonary infections, bronchial, coughs and

colds and in whooping cough. A tincture which is prepared from seed with rectified spirit of wine is very useful for the treatment of ague and fevers [28].

Helianthus tincture is use in the treatment of malarial fever. Mostly leaves are spread on a bed and covered with a cloth, moistened with warm milk after that patient is warped up in it. Perspiration is produced and this procedure is repeated until the fever has ceased. A tincture of the flowers and leaves are used in combination with balsamic in the treatment of bronchiectasis [29].

In Mexico the sunflower is use for food and also believed as medicinal in soothing chest pains. An anthropologist known Charles H. Lange at the University of Texas wrote a reliable home remedy that juice of freshly crushed sunflower stems is use for cuts and other wounds. The juice is mottled abundantly over the wounds and bandaged

and results in a speedy recovery, with never a case of infection [30].

Researchers from the Johns Hopkins University studied in between 1998 and 2003 in Bangladesh that sunflower oil can protect premature babies from bacterial infections when rubbed onto their skin several times daily. Sunflower oil can also be applied to the face and neck to treat and prevent acne breakouts. The sunflower oil protects cells from cancer-causing radicals as well as preventing infection and diseases. Oil of sunflower is use for acne treatment [31].

Pharmacological Activities of *H. annuus*

Researcher did a lot of work to investigate the biological or pharmacological activities of *H. annuus* L.

Anti-inflammatory Activities

Sunflower exhibits anti-inflammatory activity. From an n-Butanol-soluble fraction of a methanol extract of a flower petals of sunflower, two new oleanane-type triterpene glycosides, helianthosides 4(4) (Fig. 6) and 5(5), along with four known triterpene glycosides, helianthosides 1(1), 2(2), 3(3) and B (6) isolated which possess distinct anti-inflammatory activities on 12-O-tetradecanoylphorbol-13-acetate induced ear edema in mice. All of the triterpene glycosides exhibit potent inhibitory effects and are more potently inhibit [32].

Anti-asthmatic Activity

The effect of *H. annuus* L. seed aqueous extract is analyzed on an in vivo anti-asthmatic model on ovalbumin induced mice and their lungs are assess by hemotoxylin and eosin staining. By these findings it is conclude that the extract has extensive potential to reduce the asthma [33].

Antioxidant property

Sunflower plant has excellent anti-oxidant property. The antioxidant capability of the sunflower seed extracts is obtain by chronological extraction with different polarities of solvents by in vitro methods:

ferric reducing/antioxidant power, oxygen radical absorbance capacity assays and 2-diphenyl-1-picrylhydrazyl radical. It is analyze that the intake of this seed may prevent cancer and other oxidative reaction related diseases [34].

Antigen property

Different extracts from *H. annuus* exhibit inhibitory effect on Epstein-Barr virus. It is analyze that from the diethyl ether extract of the pollen grains of *H. annuus* following compounds are isolated such as four free triterpene alcohols, eight fatty acid esters of triterpene alcohols, two tochopherol-related compounds, four estolides, three syn-alkane-4, 6-diols, 1, 3-dioxoalkanoic acid and one aliphatic ketone along the mixture of free fatty acids and showed inhibitory effects on Epstein-Barr virus and early antigen induced by tumor promoter induction [35].

Antihypoglycemic effects

Ethanollic extracts of *H. annuus* exhibit antidiabetic potential. Seeds show antihyperglycemic effect in rats. It is detected that the oral administrations of ethanollic extract which contain polyphenols from *H. annuus* L. cause a decline in diabetes [36].

Antimicrobial activities

The antimicrobial activity of methanolic extract of seeds is evaluated from *Helianthus annuus* L [13]. The polar oil from the seeds of sunflower (*Helianthus annuus*) shows antimicrobial activity against *Staphylococcus epidermis*, *E. coli*, *Pseudomonas aeruginosa*, *Candida albicans*, *Staphylococcus aureus* and *Proteus vulgaris* [14].

H. annuus show better antifungal properties (Table 3). Methanol extracts of *H. annuus* seed posse's antifungal activity against fungal strains which cause various infections [36].

Conclusion

The sunflower is the center of medicinal values which is used as food and medicine

worldwide. The pharmacodynamic basis supporting the use of *H. annuus* extracts in ethnomedicinal systems has been established and pharmacological studies have demonstrated the anti-oxidant, anti-inflammatory, antitumor, antigen, antipyretic, astringent, cathartic, diuretic, antiasthmatic, stimulant, vermifuge, vulnerary purposes and antimicrobial activities and antihypoglycaemic effects of the plant extracts. The significant therapeutic effects seen by *H. annuus* are a result of the presence of an array of phytochemicals which include terpene compounds, carbohydrates, phenols, flavonoids, tannins, alkaloids, saponins, phytosterols, active proteins, fixed oils and steroids. Further illumination of the molecular mechanisms primary the activity of these chemicals is also critical to estimate the possibility of using the plant extracts for future drug development. It may direct the further research on sunflower for some activities for which it is used traditionally.

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