

Chemistry of Sunflower involving Allelochemicals and Phytochemicals

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Abstract

The Sunflower is inestimable nearly in all aspects including chemical, pharmaceutical, medical, economical, commercial, ornamental and spiritual, since ancient times. The sunflower plants are the libertine growing plants possessing wide multipurpose applications. Under this context, Sunflower oil cake is utilized in poultry feeding. The Sunflower oil is also added as a lubricant in paints and soaps. A yellow dye is made from the flower, the leaves are consumed as fodder and oil is extracted by compressing the seeds which is very nutritive and it is considered equivalent to almond or olive oil. In the last three decades people have witnessed the growth of a novel interdisciplinary branch of science named as chemical ecology, ecological biochemistry or phytochemical ecology which explains the phenomena of plant and animal interactions. Subsequently, the development in this regard discovered the phytochemicals. These phytochemicals are found in sunflowers also which are the matter of discussion due to their astonishing characteristic chemical behaviours. Phytochemicals are the active compounds, these are the non nutritive chemicals and are produced naturally by plants for creating defense against biotic and abiotic stresses. Most of the researchers applied standard methods for the screening of these phytochemicals in sunflowers. Phytochemicals exhibit physiological effects which can be accountable for its remedial potential in extensive range of disease conditions. Few of the phytochemicals are steroids, alkanes, alkaloids, fatty acids and terpenoids. While Allelochemicals are present in the roots, stems and leaves of sunflower. Sunflowers are inspiring best creative minds of the world in art and literature. With the help of thin layer chromatography for alkaloids and spectrophotometry for flavonoids and phenols these Allelochemicals can be assorted. Apart from these chemical facts, Vincent Van Gogh, the great artist in the world of art have created iconic and famed paintings of sunflower. The objective of this paper is to throw light over useful applications of sunflower, its nutritional value, chemistry and on some mythological and interesting facts about it related to its history and origin with the new innovational researches and also on discussion over its extraordinary behavior of facing towards sun which makes it distinctive from other flowers.

Keywords

Inestimable, Libertine, Phytochemicals, Allelochemicals, Spectrophotometry.

Introduction

The origin of Sunflowers is America. They were first grew in American areas now named as Southern United States and Mexico. Mexico had domestic sunflower seeds in 2100BC. Inherent American tribes cultivated sunflowers in the form of crop from Mexico to Southern Canada. Explorers were took the first crop fosters were took from America to Europe in the 16th century. Sunflower have the word flower in its actual name and like this some other flowers are cornflower, waxflower, elderflower, cone flower and safflower. The implication of Sunflower is the sun flower or flower of the sun. The scientific name of sunflower is *Helianthus Annuus* in which the word *Helianthus* derived from two Greek words *Helios* and *Anthus*. *Helios* means sun and *Anthus* means flower. The word *Annuus* represents that these flowers are annual plants and remain alive for one year only. But this is not found completely true as some sunflowers are perennials means they can live for lots of years. In the year 1903, The sunflower was declared as the official state flower of Kansas. Because of this reason the Kansas is also known as the Sunflower State. In Kansas the sunflower production is done at top level but still North Dakota is the existing place that cultivates the sunflowers most in the world. Generally the sunflowers are heighted annual or perennial plants and can achieve the height upto 300 cm or even more than that. The common sunflower that having the scientific name *Helianthus Annuus* is actually a specie of the family *Asteraceae* and it is cultivated in the world at commercial level as it has great medicinal and nutritional benefits. The sunflower belongs to the genus *Helianthus* which is the genus of about 70 species of plants of herbal use of the family *Asteraceae* native to North and South America and few species are cultivated as ornamentals as they posses striking flower heads and size and are also cultivated for their edible seeds. Name of sunflower in French is *tournesol* means turns with the sun, this name was given because sunflowers are heliotropic. Heliotropic plants are the plants that follows the sun travelling across the sky. The Seeds and sprout of sunflower consist of worthwhile antihypertensive, antimicrobial, anti inflammatory, wound healing, cardiovascular and antioxidant assistances which are present in its flavonoids, vitamins, phenolic compounds and polysaturated fatty acids. Sunflowers are utilized in ethnomedicine for the treatment of several diseaseases such as bronchial, laryngeal and pulmonary infections, heart diseases, coughs and colds and in whooping cough. The sunflower is the flower having remarkable nutritional, medicinal and culinary benefits that also provide to it and its parts it historical and growing eminence in the world.



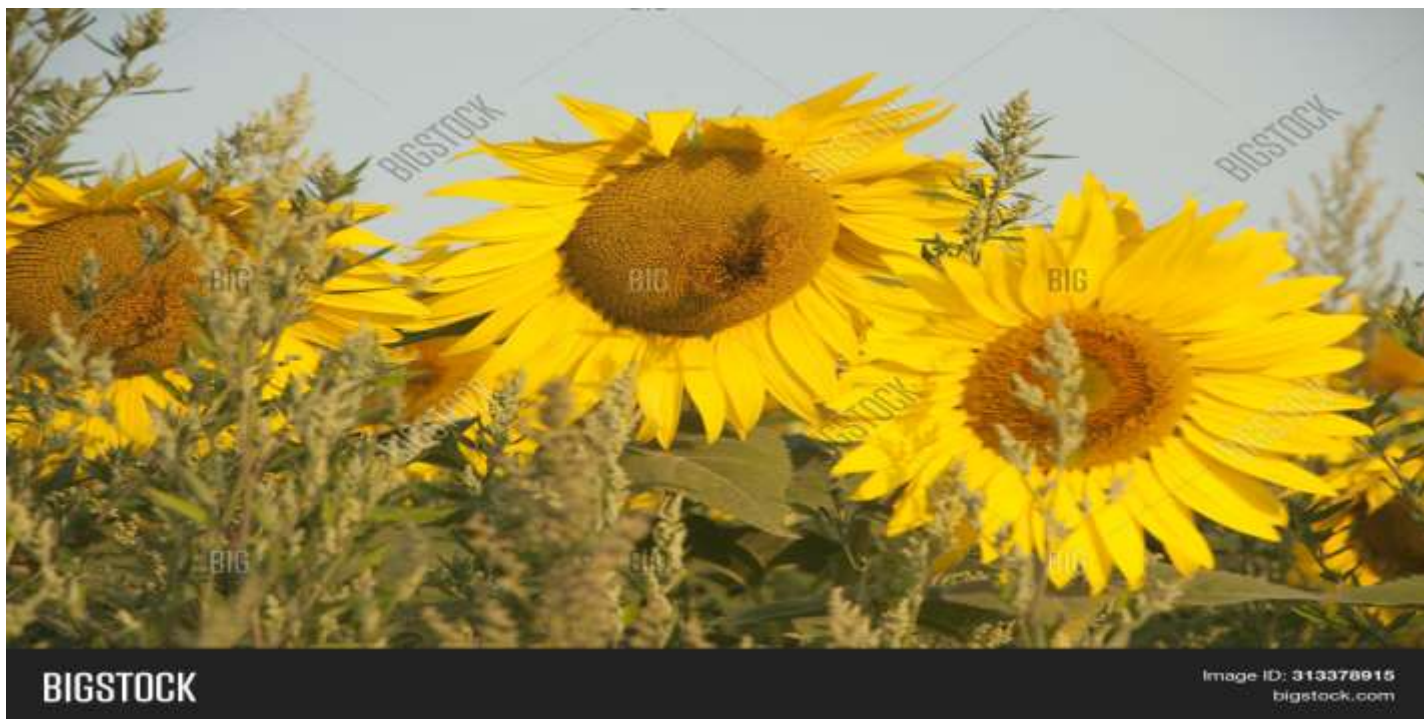
Origin Myth of Sunflower

This is the Greek mythology, it has many variations with arguments. According to this, Zeus was the king of all Gods and Men. He had a son named Apollo. He ride his chariot of gold and ivory everyday in the sky from his palace which was in the east. He travelled from east to west. He was admired by all for his beauty specially of his golden hairs and for spreading love and life to everyone. A water nymph named Clytie was in extreme tenderness with him and she starred at him with unblinking eyes. Unfortunately Apollo ignored her and leaned with Daphne, a daughter of water God. But Daphne did not respond. When Apollo tried to convince her, she asked her father to help her, he turned her into a plant. Clytie watched Apollo continuously in the sky and sat on rock for about nine days without water and food. Eventually she was turned into a flower, which is called sunflower today.



Heliotropism of Sunflower

Sunflower is heliotropic. It shows Heliotropism like some specific flowers. The terminology Heliotropism is used for the those species of flowers that follows the movement of sun in the sky from east to the west. These species are called the heliotropic species. Reserches are saying that such behavior of sunflower is scientific. Some stem cells beneath the buds are responsible for this and its leaves are phototropic. The flowers which responds with some growth in the direction of natural source of light are termed as Phototropic Flowers.



Chemistry of Sunflowers

The seeds of sunflowers are good sources of antioxidants like phenolic acids such as chlorogenic acid, gallic acid, ferulic acid, protocatechuic acid, sinapic acid, coumaric acid, caffeic acid and caffeoylquinic acid. And vitamins, trace elements and flavonoids including kaempferol, apigenin, quercetin, luteolin and heliannone. Five flavonoids are isolated from sunflowers are flavonoltambulin, flavanones heliannones B and C, helianone A, and chalconeskukulcanin B. Light coloured proteins are also derived from sunflowers these are the four isomers of tocoopherols which are alpha, beeta, gamma and delta. These isomers are also present in the sunflower seed oils. It posses helianthinin as globulin. Lipase is also isolated from the sunflowers. A 16 kDa protein, SAP 16 is isolated subsequently. The seeds of sunflowers are rich in vitamin E and it has low amounts of saturated fat. Alpha tocopherol is the most active component of this oil which provides protection against reative oxygen species. This oil is used on large scale in food industries. Sunflower seed oil remain stable at high cooking temperatures. This oil is utilized as vegetable oil as well as it is also used as a cosmetic ingradient and a lubricant. The sunflower seed extracts consist of dicaffeoylquinic acid, chlorogenic acid, caffeic acid, these are actually extracted from the aquous methanol extract of the sunflower seeds. Sunflowers mainly produces phytochemicals. Phyto is a greek word and its meaning is plant, so these are the chemicals released from plants, they posses certain biological activities and play an important role in plant growth and in defence against pathogens or predators. Though the Phytochemicals are the essential nutrients but they are still under research. The major categories of phytochemicals includes carotenoids and polyphenols which consist of flavonoids, stilbenes and phenolic acids. Flavonoids are also divided into groups like flavones, anthocyanins, flavanones, flavanols and isoflavones. Flavanols are also classifies as proanthocyanidins, catechins and epicatechins. There are about 25,000 phytochemicals are discovered. These phytochemicals and allelochemicals are produced by almost all plants from their flowers, seeds, roots, leaves, stems and rhizomes. Allelochemicals include terpentenoids and phenolic compounds like monoterpenes, steroids, phytosterols, natural monophenols, polyphenols, phenylethanoids.

Conclusion

Sunflower is a very useful flower it can also actively affect the growth of surrounding plants as possessing the allelochemicals. Sunflowers are the prime sources of phenolic antioxidants. Though sunflower oil is expensive but it has so many important industrial uses. Sunflower oil is utilized in some varnishes, paints and also in some plastics. It has semi drying properties which helps in the preservation of colours of the products. In many Eastern European countries it is used for making soaps and detergents. Even hydrogen can also be extracted from sunflower oil, it means that it is a greener option as compare to the fossil fuels for burning. It is used in making dyes and so used in various textile industries. It is a good massage oil and can be used as a beauty lotion. Skin easily absorb sunflower oil, due to this skin become hydrated and soft. It can also prevent acne. Apart from this sunflowers also have the capability to absorb radioactive emissions. It was proved during Chernobyl disaster in the year 1986, which was extremely disastrous nuclear accident. Sunflowers absorbed 95% radioactive emissions. Sunflowers are therefore amazing versatile flowers which are ever in demand at all levels including industrial, commercial, domestical, spiritual and nutritional levels.



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References

- [1] Barik, A., Bhattacharya, B., Laskar, S. and Banerjee, T. C. (2004). The determination of nalkanes in the cuticular wax of leaves of *Ludwigia adscendens* L. *Phytochemical Analysis* 15: 109–111.
- [2] Bondada, B. H., Oosterhuis, D. M., Murphy, J. B. and Kim, K. Y. (1996). Effect of water stress on the epicuticular wax composition and ultrastructure of cotton (*Gossypium hirsutum* L.) leaf, bract, and boll. *Environmental and Experimental Botany* 36: 61–69.
- [3] Bray, H. G. and Thorpe, W. V. (1954). Analysis of phenolic compounds of interest in metabolism. *Methods of Biochemical Analysis* 1: 27–52.
- [4] Bringe, K., Schumacher, C. F., Schmitz-Eiberger, M., Steiner, U. and Oerke, E. C. (2006). Ontogenetic variation in chemical and physical characteristics of adaxial apple leaf surface. *Phytochemistry* 67: 161–170.
- [5] Abe, M. and Matsuda, K. (2000). Feeding deterrents from *Momordica charantia* leaves to cucurbitaceous feeding beetle species. *Applied Entomology and Zoology* 35: 143–149.
- [6] Ardón, M. and Pringle, C. M. (2008). Do secondary compounds inhibit microbial-and insect-mediated leaf breakdown in a tropical stream, Costa Rica? *Oecologia* 155: 311–323.
- Alfatafta, A. A. and Mullin, C. A. (1992). Epicuticular terpenoids and an aurone from flowers of *Helianthus annuus*. *Phytochemistry* 31: 4109–4113.
- [7] Adati, T. and Matsuda, K. (2000). The effect of leaf surface wax on feeding of the strawberry leaf beetle, *Galerucella vittaticollis*, with reference to host plant preference. *Tohoku Journal of Agricultural Research* 50: 57–61.
- [8] Banerjee, T. C. and Haque, N. (1984a). Defoliation and yield loss in sunflower caused by caterpillars, *Diacrisia casignetum* Kollar (Lepidoptera: Arctiidae). *Indian Journal of Agricultural Science* 54: 137–141.
- [9] Awmack, C. S. and Leather, S. R. (2002). Host plant quality and fecundity in herbivorous insects. *Annual Review of Entomology* 47: 817–844.

- [10] Batovska, D. I., Todorova, I. T., Bankova, V. S., Parushev, S. P., Atanassov, A. I., Hvarleva, T. D., Djakova, G. J. and Popov, S. S. (2008). Seasonal variations in the chemical composition of vine-grape leaf surface. *Natural Product Research* 22: 1231–1236.
- [11] Applebaum, S. W. (1985). Biochemistry of digestion. In: Kerkot, G. A. and Gillbert, L. I. (eds.), *Comprehensive insect physiology, biochemistry and pharmacology*. Pergamon Press, New York, Oxford, pp 279–311.
- [12] Bomar, C. R. and Lockwood, J. A. (1994). Olfactory basis of cannibalism of grasshoppers (Orthoptera : Acrididae): II. Field assessment of attractants. *Journal of Chemical Ecology* 20: 2261–2272.
- [13] Alimohammadi, R. and Azizov, I. (2011). Defoliation effects on yield and yield components of sunflower cultivars (*Helianthus annuus* L.). *International Journal of AgriScience* 1: 361–365.
- [14] Anjum T. and Bajwa, R. (2005). A bioactive annuionone from sunflower leaves. *Phytochemistry* 66: 1919–1921.
- [15] 179 Badenes-Perez, F. R., Nault, B. A. and Shelton, A. M. (2005). Manipulating the attractiveness and suitability of hosts for diamondback moth (Lepidoptera : Plutellidae). *Journal of Economic Entomology* 98: 836–844.
- [16] Banerjee, T. C. and Haque, N. (1984b). Dry-matter budgets for *Diacrisia casignetum* larvae fed on sunflower leaves. *Journal of Insect Physiology* 30: 861–866. Banerjee, T. C. and Haque, N. (1985). Influence of host plants on development, fecundity and egg hatchability of the arctiid moth *Diacrisia casignetum*. *Entomologia Experimentalis et Applicata* 37: 193–198.
- [17] Bhyyan, I. N. (1979). Mating behavior of jute hairy caterpillar, *Diacrisia obliqua* Walker (Lepidoptera : Arctiidae). *Applied Entomology and Zoology* 14: 303–309.
- [18] Barik, A. and Banerjee, T. C. (2005). The role of triterpenes in the weed insect interaction. *Allelopathy Journal* 15: 259–266.
- [19] Bringe, K., Schumacher, C. F., Schmitz-Eiberger, M., Steiner, U. and Oerke, E. C. (2006). Ontogenetic variation in chemical and physical characteristics of adaxial apple leaf surface. *Phytochemistry* 67: 161–170.