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Review Article

PHYTOCHEMICAL AND PHARMACOLOGICAL STUDIES ON *Chrysanthemum coronarium* L.: A REVIEW

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ABSTRACT

Chrysanthemum coronarium L. is also known as Garland. The leaves are edible and its flowers have a pleasant odour. Most of the Mediterranean regions use this plant for its ornamental value and also used to treat different ailments in China and Korea. *C. coronarium* is used as nerve sedative. It has antioxidant, anti inflammatory, antimutagenic, antimicrobial, antifungal, antiangiogenic, antiatheroslerosis and nematicidal properties. Leaves are used as expectorant, bitter, and stomachic. The essential oil fractions of *C. coronarium* have many enzyme inhibitory activities. It also has cytotoxic activity; further research on this area will shed some light to develop antitumor molecules. The volatile oil components in the flowers are responsible for the pleasant fragrance. The essential oil of *C. coronarium* is abundant in terpenoids, sterols, flavonoids, polyacetylenes etc. These chemical constituents are responsible for its medicinal value. Recent studies revealed that the chemical profile of essential oil of *C. coronarium* can differ between harvesting seasons and between geographical sources. Further research is required to determine the true bioactivity of essential oil of *C. coronarium* and its constituents.

Key words: *C. coronarium*, terpenoids, essential oil, antimicrobial, insecticidal.

INTRODUCTION

Chrysanthemum coronarium L. is an important medicinal plant commonly known as pyrethrum plant or “Tango” as a weed in cereals. It is a member of Compositae or Asteraceae family, subfamily Asteroideae, order Asterales, subclass Asteridae, tribe Anthemideae. The species is an ornamental plant[1]. It is an herbaceous annual plant with aromatic flavour, stems are up to 100 cm and branched. Leaves are oblong, mostly 2-pinnatisect, yellow florets and it has big capitula, usually bicolored white and yellow[2].

Chrysanthemum plants, apart from their ornamental value, are highly aromatic due to the many volatile components of their essential oils, many of which are used in the flavour and fragrance industries. Flower heads of *C. coronarium* are often used as chamomile adulterants. While in Japan the leaves are used for suppression of fishy odours in foods such as Japanese-style soup, yuzu or in Japanese pepper [3].

GEOGRAPHICAL DISTRIBUTION

It is available in tropical and subtropical zones[4] and widely distributed in the Mediterranean region, Japan, China and the Philippines[5]. The diploid and tetraploid taxa of the *Chrysanthemum* are distributed mainly in Mediterranean region and Europe[6].

USES:

The variety ‘spatiosum’, is appreciated as a Chinese vegetable. Other uses of this species have been reported in the literature. Different parts of the plant are used for treating different ailments .The leaves are expectorant, stomachic and to treat inflammation. Bark is purgative and also to treat syphilis. It is used against constipation, intestinal parasitic infections and effective in the fight against nematodes and protects plants against caterpillars. The extract of *C. coronarium* showed strong and selective allelopathic activity[7]. Flowers arestomachic, insecticidal and it is well known for its use against skin allergies like itch[8].

PHARMACOLOGICAL PROFILE:

- The plant *C. coronarium* has insecticidal, antifeedant and repellent properties in its flower, leaf and also in the whole plant extracts. The extracts or its dry powders have bioactivity against a wide range of the insect pests of agriculture. It was found that the plant *Chrysanthemum* has toxic effect especially on the development of *Spodoptera sp.* Insect anti juvenile hormone activity has

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been detected for some of polyacetylenic compounds isolated from the aerial parts[9].

- Nematicidal property[10].
- *C. coronarium* flowers are used as a substitute for central nerve sedative, aromatic and bitter. Dried flowers are taken as a tea to reduce stomach trouble. Cumumbrin B has a strong effect on blood pressure reduction. These sesquiterpene lactones were reported a strong invitro cytotoxic activity against A549, PC-3 and HCT-15 cell lines and invitro growth inhibitory activity with the sulforhodamin B assay (SRB)[11].
- It has been reported that the leaf of *C. coronarium* possess antifungal, Antioxidant[12,13] antiangiogenic[14] and antiatheroslerosis effect (methyl-trans-ferulate : reduce low density lipoprotein. Inhibitory effect on the activity of ACAT (Acyl-CoA: cholesterol acyltransferase), the catalyzing enzymes of the intracellular esterification of cholesterol, and FPTase (Farnesyl-protein transferase), the farnesylation enzymes for Ras protein in charge of cancer promotion, PLT aggregation, and the growth of HUVEC (Human *umbilical* vascular endothelial cell) or A549 cells[15].
- *C. coronarium* contains chlorogenic acid which is responsible for its anti oxidant antimutagenic properties. The plant *C. coronarium* has promising anti inflammatory properties and this bio activity is due to the high polyphenols contents[16].
- Antagonistic activity at selected biogenic amine receptors on smooth muscle of the airways, gastrointestinal tract and vascular system[17].
- The oil was unable to reduce the DPPH radical, while it exhibited a good antimicrobial activity against the gram-positive bacteria *B. aereus* and *S. aureus.* The aqueous extracts suppress the germination and reduce the seedling growth of the target species. A strong and selective allelopathic(phytotoxic) activity against weeds with the effects being more pronounced in *S. arvensis* and *P. canariensis*[18].
- The essential oil of *C. coronarium* reported to has low activity against *Staphylococcus aureus*, while its activity against *Salmonella* sp and *Shigella* sp is present only with pure oil. The dilutions have no effect on bacteria mentioned. The remains of the tested bacteria are resistant to *C. coronarium* oil. But, the essential oils of *C. coronarium* of Italy have no activity against *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*[7].
- Karyological result of *C. coronarium* is reported have 2n = 36, and also reported a diploid with 2n = 18 in the Mediterranean. The Turkey and Egypt populations of *C. coronarium* have diploid with 2n = 18. The basic chromosome number of *C. coronarium* is x = 9. This number is most common in the genus *Chrysanthemum*, in the tribe *Anthemideae* well as in the family *Asteraceae*, it is the ancestral basic number[7].

ESSENTIAL OIL ANALYSIS

The hydrodistillation of the essential oil of *C. coronarium* gave a viscous liquid with a colour of yellow. The essential oils were analysed by Takia Lograda et al.,(2013) on a Hewlett-Packard gas chromatograph Model 5890, coupled to a Hewlett-Packard model 5971, equipped with a DB5 MS column (30 m X 0.25 mm; 0.25 µm), programming from 50°C (5 min) to 300°C at 5°C/min, with a 5 min hold. Helium was used as the carrier gas (1.0 mL/min); injection in split mode (1:30); injector and detector temperatures, 250 and 280°C, respectively. The mass spectrometer worked in EI mode at 70 eV; electron multiplier, 2500 V; ion source temperature, 180°C; MS data were acquired in the scan mode in the *m/z* range 33-450. The identification of the components was based on comparison of their mass spectra with those of NIST mass spectral library[7].

The volatile components in the product have significant influence on its taste and quality. The quality and yield of essential oils, usually extracted by steam distillation, from Anthemideae plants is influenced by the harvesting season, fertilizer and the pH (ideal in acidic, pH 4.5-5.4) of soils , the choice and stage of drying conditions, the geographic location , chemotype or subspecies , choice of plant part or genotype or extraction method[14].

CHEMICAL COMPOSITION OF *CHRYSANTHEMUM CORONARIUM*:

The HS–LPME–GC method was used to characterize and semiquantify the volatile components in *C. coronarium* and revealed many terpenoids[19]. Different parts of the plant possess different variety of chemical components. It includes Terpenoids, Sesquiterpene lactone, Dihydrochrysanolide derivatives, Polyacetylenes, Flavonoids, phenolic, campesterol compounds and Sterols.

Flowers:

Cumambrin A, a sesquiterpene-lactone, was also isolated from the *C. coronarium* and has been shown to cause hypotension in rats[20,21]. Pyrethrosin Derivatives like Pyrethrosin, 1,10-epi- Pyrethrosin, tulirinol also reported in the flowers of *C. coronarium*[11]. Dicaffeoylquinic acid, succinoyl- Dicaffeoylquinic acid and acetylmycosinol were released from *C. coronarium* as significantly different features during the blanching process within a short time

(1-3 min at 95 °C). Dicaffeoylquinic acid, succinoyl-Dicaffeoylquinic acid were the main contributors to changes in the antioxidative activity of *C. coronarium* during blanching[12].

Leaves:

Ethyl acetate fraction of *C. coronarium* leaves contains 3-dihydro-methylene-2- (3H) furanone, jasmolin I, carveol 1, phosphoric acid, tributyl ester and cinerin II, while those of chloroform fraction were 5-hydroxy-3 methyl-1H-pyrazole, and carveol[19]. A diterpene, ent-kaurane-3β-16β -diol also present[22].

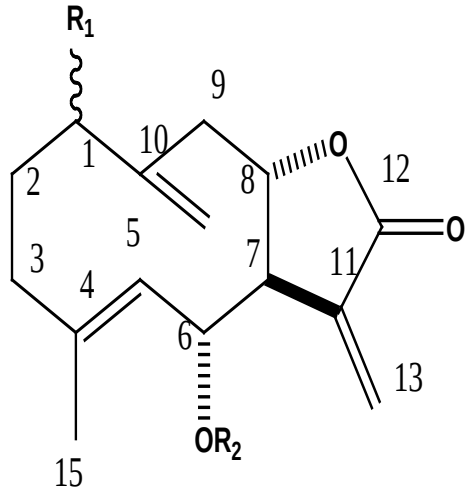
Aerial parts: It mainly contains Polyacetylenes and Sterols. Repeated column chromatography of EtOAc and n-BuOH fractions gave nine polyacetylens, which were reported as 2-[(lZ,4Z)-5-methylsulfinyl-2-pentyn-4-enyliden]-1,6- dioxaspiro [4,4] non-3-ene, 2-[(IE,4Z)-5-methylsulfinyl-2-pentyn-4-enyliden]-1,6-dioxaspiro[4,4]non-3-ene, 2-[lZ-2,4-dipentyn-6-methy-liden]-1,6-dioxaspiro[4,4]non-3-ene, 2-[lE-2,4-dipentyn-6-methyliden]-1,6-ioxaspiro[4,4]non-3-ene, 2-[lE-2,4-di-pentyn-6-methyliden]-1,6-dioxaspiro[4,5]non-3-ene, 2-[lZ-2,4-dipentyn-6-methylidene]-1,6-dioxaspiro [4,4]non-3,7-dien-9a-ol, 2-[lE-2,4-dipentyn-6-methyliden] -1,6-dioxaspiro[4,4]non-3,7-dien-9b-ol, 2-[lE-2,4-dipentyn -6-methyliden]-1,6-dioxaspiro[4,4]non-3,7-dien-9a-ol and 2-[1Z-2,4-dipentyn-6-methyliden]-1,6-dioxaspiro[4,4]non-3,7-dien-9b-o1. EtOAc fraction have been reported to contain four sterols, whose chemical structures were established as stigmast-4-en-6b-o1-3-one, stigmast-4- en-6a-ol-3-one, which have been so far reported only in the aquatic plants and were isolated for the first time from the land plants, β-sitosterol and daucosterol[15].

The chemical composition of essential oils of *C. coronarium* is highly variable. The major compounds are α-pinene, β-pinene, transchrysanthenyl acetate, trans-chrysanthenyl isovalerate, cischrysanthenyl acetate, camphene and myrcene. For the essential oil of *C. coronarium*, the major components are the 1, 1-Difluror-tetramethylcyclopropane (11.52%), santolina triene (10.38%), 2-octen-4- one, 2-methyl-1,5-heptadien-4-one,3,3,6trimethyl (8.7%) and lyratyl acetate (5.9%). Chamazulene which gave the blue color to the oil was present (0.95%)[7].

The chemical profile of the essential oil of *C. coronarium* (of the region Aouakas, Algeria) is different from those reported by other authors. These sample contains high percentages of 1, 1-Difluror-tetramethylcyclopropane, camphor and santolina triene, these components are absent in populations of Greece and Italy, while the trans-chrysanthenyl acetate, cis-chrysanthenyl acetate, the β-Pinene oxide and trans-Tonghaosu are absent in the sample of Algeria[7].

The essential oil of *C. coronarium also* reported to have (*E*)-β-farnesene, germacrene-D and camphor. HPLC– PDA-MS analysis allowed the identification of chlorogenic acid acid, di-cafeoylquinic acids isomers, rutin, luteolin, luteolin-7-*O*-glucoside, myricetin-3-*O*-galactoside and tricin[18]. 5-5'-dibutoxy-2, 2'-bifuran, methyl-trans-ferulate, prunasin, sambunigrin, pterolactam and adenosine[23]. trans-2-(hexa-2,4-diyn-1-yliden)-1,6-dioxaspiro[4,4]non-3-ene[3] and a Sesquiterpene lactone, 1-Epi-dihydrochrysanolide, Dihydrochrysanolide derivatives: 1-α-Hydroxy-1-desoxotamirin also have been reported[24].

STRUCTURES OF SOME MAJOR CHEMICALS:



	R_1	R_2
1. 1-Epi- dihydrochrysanolide	▬ OH	Ac
2. dihydrochrysanolide	⁞⁞⁞⁞⁞⁞⁞⁞⁞ OH	Ac
3. 1- alpha-Hydroxy-1-desoxotamirin	⁞⁞⁞⁞⁞⁞⁞⁞⁞ OH	H

Figure 1:

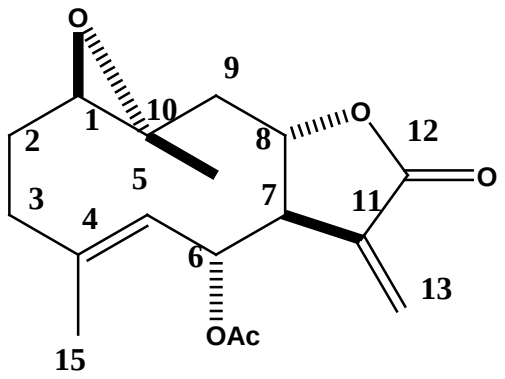


Fig. 2 Pyrethrosin

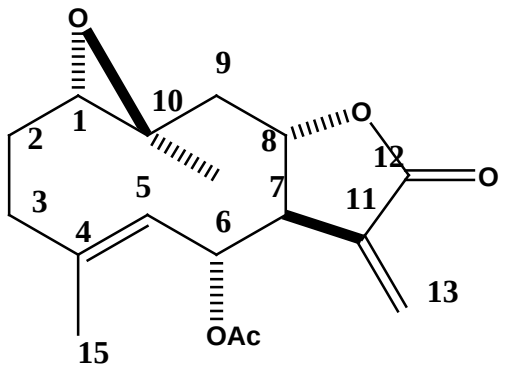


Fig. 3 1,10-epi-pyrethrosin

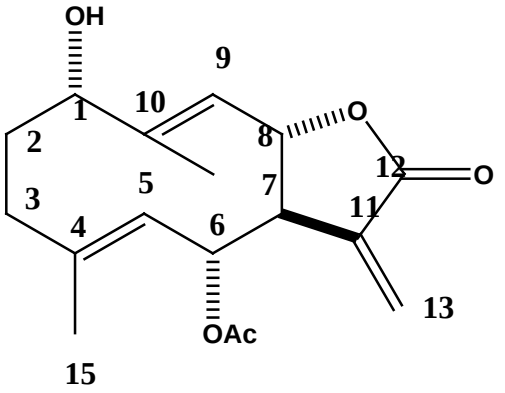


Fig. 4 Tulirinol

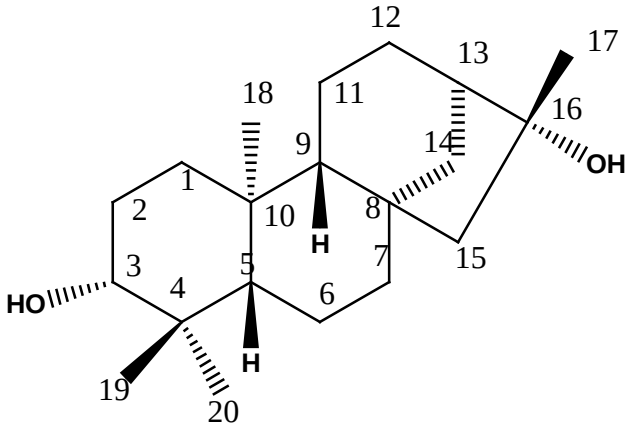


Fig. 5 kaurane-3beta-16beta -diol

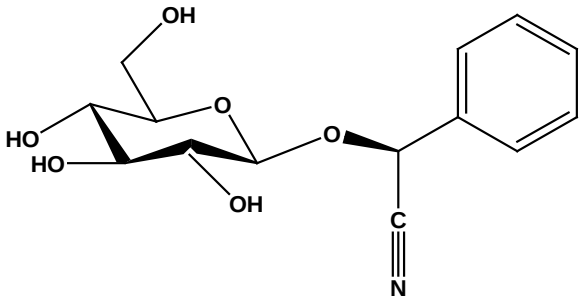


Fig. 6 Sambunigrin

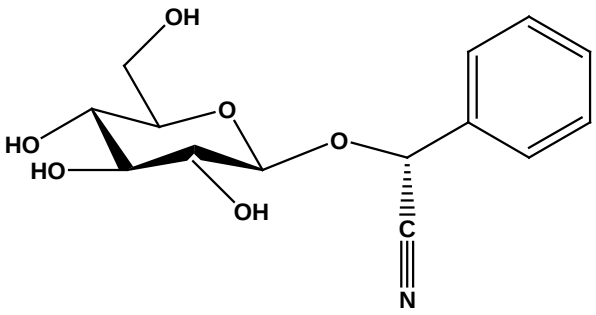


Fig. 7 Prunasin

CONCLUSION

Besides its ornamental and edible purpose,it is imperative to identify the bio active compounds which are responsible for its pharmacological properties especially in the essential oil of the plant. There is a need of focus on the chemical constituents of this plant to develop anticancer drugs from the aerial parts of the plant.

REFERENCES:

1. Su las L, Re GA, Molle G, Ligios S. *Chrysanthemum coronarium* L.: A new pasture species for Mediterranean forage systems. In : EtienneM. (ed.). Dynamics and sustainability of Mediterranean pastoral systems. Zaragoza. CIHEAM, 83-86, 1999.

2. Pignatti, S. Flora d'Italia. Edagricole Bologna, 87, 1982.

3. Jaime A. Teixeira da Silva. Mining the essential oils of the Anthemideae. African Journal of Biotechnology, 3 (12), 706-720, 2004.

4. Prakash A, J. Rao. Botanical pesticides in agriculture. Lewis publishers, New York, London, Tokyo.

5. Sanchez-Monge E. Flora agricola. Tomo I. Ministerio de Agricultura, Pesca y Alimentacion, Secretarıa General Tecnica, Madrid, 1294 p, 1991.

6. Dowrick GJ. The chromosomes of *chrysanthemum* I, The species, 6, 365-375, 1952.

7. Takia Lograda, Messaoud Ramdani, Pierre Chalard, Gilles Figueredo, Hafsa Silini Meriem Kenoufi. Chemical composition, antibacterial activity and chromosome number of Algerian populations of two *chrysanthemum* species. Journal of Applied Pharmaceutical Science, 3 (8 Suppl 1), S6-S11, 2013.

8. Boulos, L. Medicinal plants of North Africa. Reference publications, Inc., Algonac, Michigan, USA 1983.

9. Mourad L. Shonouda, Salah Osman, Osama Salama, Amal Ayoub. InsecticidalEffect of *Chrysanthemum coronarium L.* Flowers n the Pest *Spodoptera littoralis* Boisd and its Parasitoid *Microplitis rufiventris* Kok. With Identifying the Chemical Composition. Journal of Applied Sciences, 8(10), 1859-1866, 2008.

10. Bar-Eyal Meira, Sharon Edna, Spiegel Yitzhak. Nematicidal activity of *Chrysanthemum coronarium*, European J. of Plant Pathology, 114, 427-433, 2006.

11. Kyung Dong Lee, Ki Hun Park, Tae Joung Ha,Hyo Shim Han, Min Suk Yang. Isolation of Pyrethrosin Derivatives from the Flower of *Chrysanthemum coronarium* L. *Agric. Chem. Biotechnol*, 46(2), 76-79, 2003.

12. Jiyoung Kim, Jung Nam Choi, Kang Mo Ku, Daejung Kang, Jong Sang Kim, Jung Han Yoon Park, Choong Hwan Lee. A correlation between Antioxidant Activity and Metabolite Release during the Blanching of *Chrysanthemum coronarium L.* Bio sci Biotechnol Biochem, 75(4), 674-680, 2011.

13. Jong-Sang Kim, Ji Yeon Seo, Young Ran Ha, Ji Sun Lim, Inae Lee,Soon Sung Lim, Jung Han Yoon Park, Tony An Kong, ChoongHwan Lee. Antioxidant Effects of Ethyl Acetate-Soluble Fraction of *Chrysanthemum coronarium*. The FASEB Journal, 22: 890.19, 2008.

14. Choi JM, Lee EO, Lee HJ, Kim KH, Ahn KS, Shim BS, Kim NI, Song MC, Baek NI, Kim SH. Identification of campesterol from *Chrysanthemum coronarium* L. and its antiangiogenic activities. Phytother. Res., 21, 954–959, 2007.

15. MCh. Song, DH. Kim, YH. Hong, HJ. Yang, IS. Chung, SH. Kim, BM. Kwon, DK. Kim, MH. Park and NI. Baek. Polyacetylenes and Sterols from the Aerial Parts of Chrysanthemum coronarium L. (Garland). Frontiers in Natural Product Chemistry, Vol. 1, 2005.

16. Strzelecka M, M. Bzowska, J. Koziel, B. Szuba, O. Dubiel, D. N. Rivera, M. Heinrich and J. Bereta. Anti-inflammatory effects of extracts from some traditional Mediterranean diet plants. J Physiol Pharmacol, 56(1), 139-156, 2005.

17. Gaudencio M. Natividad. Thesis, Isolation and Chemical and Pharmacological Characterization of Potential Trace Amine-Associated Receptor Antagonist from Plant Sources. Division of Pharmacology Welsh School of Pharmacy Cardiff University, Cardiff, UK 2010.

18. Karim Hosnia, Imed Hassenb, Houcine Sebeic, Herve Casabiancad. Secondary metabolites from *Chrysanthemum coronarium*(Garland) flowerheads, Chemical composition and biological activities. Industrial Crops and Products, 44, 263–271, 2013.

19. Guoqing Wang, Chunhong Dong, Yu-an Sun, Kui Xie, Haiyu Zheng. Characterization of Volatile Components in Dry Chrysanthemum Flowers Using Headspace–Liquid-Phase Microextraction–Gas Chromatography. Journal of Chromatographic Science, 46, 20, 2008.

20. Song, M-C, Kim, D-H, Hong, Y-H, Kim, D-K, Chung, l-S, Kim, S-H, Park, M-H, Kwon, B-M, Lee, YH, Baek, N-l. Search for biologically-active materials from edible plant resources. Part VII. Terpenes from the aerial parts of *Chrysanthemum coronarium* L. *Agricultural Chemistry and Biotechnology (English Edition)*, 43(3), 118-121, 2003b.

21. Song, M-C, Hong, Y-H, Kim, D-H, Kim, D-K, Chung, l-S, Lee, Y-H, Kim, S-H, Park, M-H, Kim, l-H, Kwon, BM, Baek, N-l. Development of biologically active compounds from edible plant sources. VI. Isolation of sterol com pounds from th e aerial parts of garland (*Chrysanthemum coronarium* L.). *Han'guk Nonghwa Hakhoechi* , 46(4), 376-379, 2003a.

22. Consolacion Y. Ragasa, Gaudencio M. Nativdad, John A. Rideout. An Antimicrobial Diterpene from *Chrysanthemum coronarium*. KIMIKA, 14(1), 17-20, 1998.

23. Song MC, Yang HJ, Jeon TS, Kim KT, Baek NI. Heterocyclic compounds from *Chrysanthemum coronarium L*. and their inhibitory activity on hACAT-

1, hACAT-2, and LDL-oxidation. Arch pharm Res, 31(5), 573-8, 2008.

24. Kyung Dong Lee, Min Suk Yang, Tae Jung Ha, Ki Min Park, Ki Hun Park. Isolation and Identification of Dihydrochrysanolide and its 1- Epimer from *Chrysanthemum coronarium.* Bio sci Biotechnol Biochem, 66(4), 862-865, 2002.