International Journal of Homoeopathic Sciences

E-ISSN: 2616-4493
P-ISSN: 2616-4485
Impact Factor (RJIF): 5.96
www.homoeopathicjournal.com
IJHS 2025; 9(3): 960-964
Received: 10-06-2025
Accepted: 12-07-2025

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Comparison of antioxidant property and anti-inflammatory property of *Coriandrum sativum* crude extract and homoeopathic *Coriandrum sativum* q- *in vitro*

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DOI: https://www.doi.org/10.33545/26164485.2025.v9.i3.O.1773

Abstract
Background: Coriander (*Coriandrum sativum* L.) is a member of the Apiaceae family and it is among most widely used medicinal plant, possessing nutritional as well as medicinal properties. The aim of this study is to compare the antioxidant property and anti-inflammatory property of *Coriandrum sativum* crude extract and homoeopathic *Coriandrum sativum* Q using DPPH assay and CoX_2 assay respectively.
Objective: To. compare the antioxidant property between *Coriandrum sativum* plant extract and *Coriandrum sativum* Q using DPPH assay. To compare the anti-inflammatory property between *Coriandrum sativum* plant extract and *Coriandrum sativum* Q using CoX_2 assay.
Materials and Methods: The *Coriandrum sativum* whole plant and the crude plant extract was collected from it and was marked as sample A, then commercially purchased *Coriandrum sativum* Q was labelled as Sample B. Now the sample A is undergone for anti-oxidant property using DPPH assay and the anti-inflammatory using CoX_2 assay. Then the sample B is also made to undergo the same antioxidant property using DPPH assay and the anti-inflammatory using CoX_2 assay. After the result obtained from the assay it is compared with each other and seen whether there is any difference between antioxidant property and anti-inflammatory property of both samples.
Outcome: In the comparison of the anti-inflammatory and antioxidant activities of *Coriandrum sativum* plant extract and its homeopathic tincture (Q), the tincture showed better anti-inflammatory activity at lower concentrations and better antioxidant activity in overall when compared to the plant extract.

Keywords: *Coriandrum sativum* plant extract, *Coriandrum sativum* Q, antioxidant property, anti-inflammatory property, CoX_2 assay and DPPH assay

Introduction

Coriandrum sativum (C. sativum) or coriander is one of the most popularly used spices in culinary worldwide, and its medicinal values has been recognized since ancient time [1].

A number of important bioactive substances, such as sterols, carotenoids, fatty acids, tocols, and essential oils, are found in coriander. Numerous factors, including the plant's genetic composition, cultivar type, seasonal timing, ecological environment, cultivation techniques, developmental phase, specific plant part used, and harvest timing, might affect the concentration and chemical composition of these compounds. Furthermore, a variety of antibacterial and antioxidant qualities are displayed by coriander and its many extracts, adding to its potential as a medicine [2].

Among the most widely used medical herbs, coriander (*Coriandrum sativum* L.), a member of the Apiaceae family, is prized for its nutritional and therapeutic properties. Although the chemical composition and biological effects of its bioactive elements have been investigated, the results are still scattered across different sources. Every portion of the plant has historically been used in folk medicine to treat a variety of illnesses [3].

Essential micronutrients and vital nutritional components abound in coriander. Antioxidant, anti-diabetic, anti-mutagenic, anti-anxiety, and antibacterial activities are only a few of its well-known health-promoting qualities. It also helps maintain hormonal balance and provides pain relief, which makes it a popular ingredient in cooking. Its application in both conventional and contemporary diets is further supported by its capacity to improve general health and prolong food's shelf life [4].

The natural antioxidants found in medicinal herbs, which function as reducing agents in biological systems, are primarily responsible for their therapeutic qualities. The presence of bioactive compounds such flavones, isoflavones, flavonoids, anthocyanins, coumarins, lignans, catechins, and iso-catechins is mostly responsible for the antioxidant benefits. Finding strong antioxidants that provide therapeutic advantages with little or no side effects is therefore of increasing scientific interest, particularly for application in preventative healthcare [5].

An antioxidant is defined as any substance that, when present at low concentrations as compared to those of an oxidizable substrate, significantly delays or prevents oxidation of that substrate. Antioxidants help to protect the human body against damages induced by reactive free radicals generated in atherosclerosis, ischemic heart disease, cancer, Alzheimer's disease, Parkinson's disease, and even in aging process. Anti-oxidative capacities of different parts of C. sativum were evaluated by determining its effect on scavenging the diphenyl picrylhydrazyl (DPPH) radical. Polyphenolic compounds are present in C. sativum, and are known to be excellent antioxidants [6].

Antioxidants are considered as major nutraceuticals due to their wide-ranging health advantages. Standardized testing techniques are crucial for guaranteeing dependability and uniformity across different research projects. The DPPH assay is a frequently employed technique that depends on the characteristics of 1,1-Diphenyl-2-picryl-hydrazyl, a stable free radical distinguished by an unpaired electron on a nitrogen atom inside its structure. This assay's basic idea is to quantify a substance's capacity to scavenge or neutralize this radical in order to determine its potential as an antioxidant [7].

Coriandrum sativum has been shown to have strong anti-inflammatory effects in studies including both living things and laboratory settings. According to these research, the plant alters a number of signalling pathways that contribute to the body's inflammatory response and affects important inflammatory mediators [8].

Studies involving molecular docking and molecular dynamics simulations have indicated that compounds such as Angelicin, Luteolin, Coriandrin, and Ligustilide may possess promising anti-inflammatory properties. These findings offer valuable understanding of coriander's potential role in managing and preventing inflammation-related health conditions [9].

In the generation quantity of inflammatory cytokines such as TNF-α and IL-1β in cell culture medium, the expression levels of inflammatory proteins in cells were showed decrease with the increase of concentration. Therefore, we suggest that the C. sativum should be a potential source of alternative anti-inflammatory drug with good anti-inflammatory effects [10].

Materials

- The coriander plant is purchased from the nearby agricultural field.
- *Coriandrum sativum* Q is purchased from the Dr. Willmar Schwabe GmbH & Co. KG.

Methodology

The type of study is experimental study.

The study setting was done in a laboratory doing COX_2 assay and DPPH assay for assessing anti-inflammatory property and anti-oxidant property.

The *Coriandrum sativum* whole plant and the crude plant extract was collected from it and was marked as sample A, then commercially purchased *Coriandrum sativum* Q was labelled as Sample B. Now the sample A is undergone for anti-oxidant property using DPPH assay and the anti-inflammatory using COX_2 assay. Then the sample B is also made to undergo the same antioxidant property using DPPH assay and the anti-inflammatory using COX_2 assay. After the result obtained from the assay it is compared with each other and seen whether there is any difference between antioxidant property and anti-inflammatory property of both samples.

Detailed methodology

Sample collection - Sample A

The *Coriandrum sativum* whole plant were collected from the agricultural land and dried in shade to remove the moisture content and processed by percolation extraction. The solvent used in the study was ethanol.

Extraction method

Percolation method

A percolator is a device used in this process. A 2-gram sample is first moistened with 80 millilitres of ethanol and allowed to sit in a tightly sealed container for approximately four hours. Following this time, the mixture is put into the percolator, its bottom outlet closed, and it is left there for a whole day without being touched. After 75% of the total volume needed has been added, the solvent addition is stopped. Filtration and decantation are then used to gather the resultant extract [11].

Sample collection and processing- sample B

The *Coriandrum sativum Ø* (Sample B) was commercially purchased from Willmar Schwabe India Pvt Ltd.; So, sample identification, collection and preparation are not required.

Anti-inflammatory activity

Inflammation is a symptom associated with many diseases. Although steroidal and non-steroidal anti-inflammatory drugs are frequently used to treat this illness, long-term use frequently results in severe side effects. Natural materials have therefore drawn interest as potential sources for the development of novel anti-inflammatory drugs with lower health concerns.

The anti-inflammatory activity of *Coriandrum sativum* ethanol extracts (Sample A) and commercially purchased *Coriandrum sativum Ø* (Sample B) was performed using Cyclo oxygenase-2 method.

Anti-inflammatory studies by HRBC membrane stabilization method

An identical volume of Alsever's solution, which contains 2% dextrose, 0.8% sodium citrate, 0.5% citric acid, and 0.42% sodium chloride, was mixed with blood samples drawn from healthy participants. After washing the red blood cells with 0.9% isosaline, a 10% cell suspension was made. The test sample was prepared at different concentrations (12.5, 25, 50, 100, and 200 µg/ml). 0.5 ml of the HRBC solution, 2 ml of hyposaline, and 1 ml of phosphate buffer were added to each sample. After 30 minutes of incubation at 37°C, these mixtures were centrifuged for 20 minutes at 3000 rpm. A UV-visible

spectrophotometer set to 560 nm was used to detect the amount of hemoglobin released after the supernatant was carefully removed. The reference standard was diclofenac sodium [12].

Percentage of haemolysis was calculated using the formula given below

$$\text{Percentage of haemolysis} = \frac{100 - \text{Sample optical density}}{\text{Control optical density}} \text{ x } 100$$

Anti-inflammatory activity is percent of protection and is calculated using the formula

Percentage of protection = 100 - Haemolytic percentage

Anti-oxidant activity

Antioxidants are substances that help safeguard cells from the harmful effects of free radicals unstable molecules capable of damaging DNA, cell membranes, and other cellular components. These compounds are often consumed as dietary supplements to promote general health and wellness. Natural sources are increasingly being explored for their potential to yield new antioxidant agents. In this context, the antioxidant properties of *Coriandrum sativum* were assessed using ethanol-based extracts (Sample A) and a commercially available preparation (Sample B), employing the 2,2-Diphenyl-1-picrylhydrazyl (DPPH) assay method.

DPPH radical scavenging activity

The antioxidant potential of the sample fractions was assessed in vitro using the DPPH assay, following the established protocol by Williams *et al*. (1995). To prepare the stock solution, 24 mg of DPPH was dissolved in 100 ml of ethanol and stored at 20°C until use. A working solution was made by further diluting the stock with ethanol. For the test, 3 ml of this working solution was combined with 1 ml of the sample at concentrations of 20, 30, and 40 µg/ml. The mixture was thoroughly shaken and kept in the dark at room temperature for 15 minutes. After incubation, the absorbance was recorded at 517 nm. A control sample, containing no test compound, was used for comparison, and the percentage of DPPH radical scavenging was calculated accordingly [13].

$$\text{Percentage of inhibition} = \frac{(\text{Control OD} - \text{sample OD})}{(\text{Control OD})} \times 100$$

Results

Anti-inflammatory activity

The determination of COX_2 assay was done as per T.G. Ajithkumar *et.al*., the COX activity was monitored by finding the percentage of protection after analysing the haemolytic percentage which is shown in Table 1.

Table 1: Percentage of haemolysis for anti-inflammatory property

Sample	Percentage of haemolysis (%)				
	12.5 µg/ml	25 µg/ml	50 µg/ml	100 µg/ml	200 µg/ml
Coriandrum sativum Q	12.05± 0.041	20.21± 0.037	76.13± 0.028	82.39± 0.035	82.57± 0.018
Coriandrum sativum extract	30.74 ±0.026	47.39± 0.043	68.82± 0.004	69.29± 0.007	88.20± 0.004
Std (Diclofenac sodium)	35.22± 0.443	43.71± 0.886	47.48± 0.447	68.87± 0.771	80.88± 0.367

Percentage of protection = 100 - Haemolytic percentage

Table 2: Percentage of protection for anti-inflammatory property

Sample	12.5 µg/ml	25 µg/ml	50 µg/ml	100 µg/ml	200 µg/ml
Coriandrum sativum Q	87.95	79.79	23.87	17.61	17.61
Coriandrum sativum extract	69.26	52.61	31.18	30.71	11.8
Std (Diclofenac sodium)	64.78	56.29	52.52	31.13	19.12

From the above results, in 12.5 µg/ml and 25 µg/ml *Coriandrum sativum* Q showed best percentage of protection. In 50 µg/ml, 100 µg/ml and 200 µg/ml, the standard (Diclofenac sodium) showed best percentage of protection, when compared between *Coriandrum sativum* Q and *Coriandrum sativum* extract, *Coriandrum sativum* extract showed best percentage of protection in 50 µg/ml and 100 µg/ml. In 200 µg/ml *Coriandrum sativum* Q showed best percentage of protection. The result is shown in the Table 2. It is graphically represented in Fig 3.

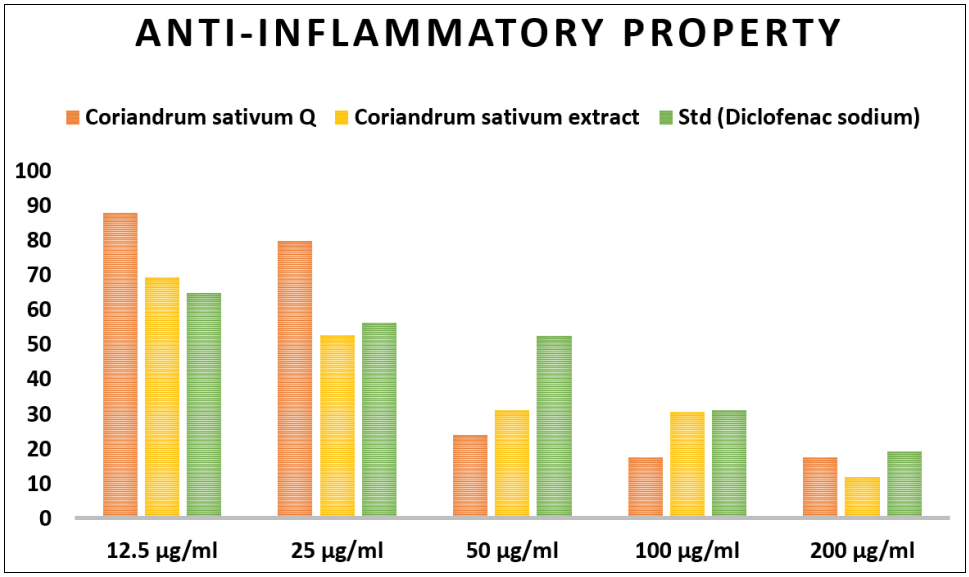

Fig 1: Graphical representation of percentage of protection in anti-inflammatory property

Anti-oxidant activity

The determination of DPPH assay was done as per Williams, BW *et.al*., the DPPH activity was monitored by finding the percentage of inhibition and tabulated in Table 3.

Table 3: Percentage of inhibition for anti-oxidant property

Concentration	Sample		Standard
	***Coriandrum sativum* Q**	***Coriandrum sativum* extract**	**Ascorbic acid**
20 µg/ ml	10.289 ± 0.012	6.841 ± 0.016	35.421 ± 0.207
30 µg/ ml	15.774 ± 0.006	8.814 ± 0.015	62.697 ± 0.709
40 µg/ ml	19.607 ± 0.041	12.167 ± 0.029	92.476 ± 0.016
IC 50 Value	104.644	182.933	25.256

From the above Table 3 it was easy to conclude that at 20 µg/ ml, 30 µg/ ml and 40 µg/ ml, standard ascorbic acid showed best anti-oxidant property and the second-best result was shown by *Coriandrum sativum* Q. The IC 50 values showed that standard showed best anti-oxidant property and the second best was shown by *Coriandrum sativum* Q. The results of various concentration are shown in Fig 4.

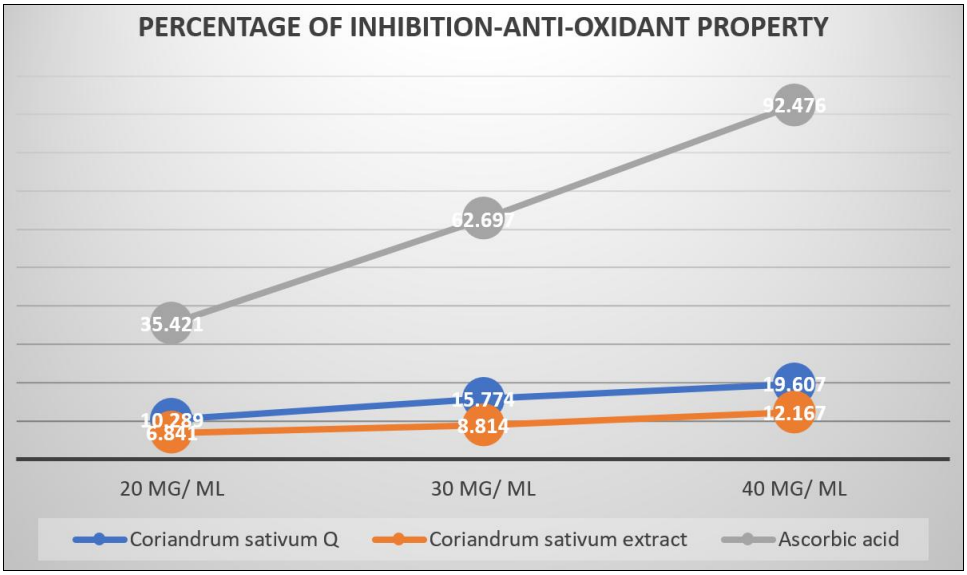

Fig 2: Graphical representation of percentage of inhibition in various concentration in anti-oxidant property

Discussion

The discussion of the study provides valuable information about the anti-inflammatory activity and the anti-oxidant activity of the *Coriandrum sativum* Q and *Coriandrum sativum* plant extract.

According to the study conducted by Gupta Sonika *et al*., in 2010 provided a result that *Coriandrum sativum* has anti-inflammatory property. From the research conducted, it is again confirmed that both the homoeopathic tincture and the plant extract of *Coriandrum sativum* has anti-inflammatory property.

According to the research conducted by Deepa. B and Anuradha. C.V in 2011 has shown that *Coriandrum sativum* seed has anti-oxidant property. By this research it is proved that homoeopathic tincture and plant extract of the *Coriandrum sativum* has anti-oxidant property.

According to the research conducted by Ahmed. I. Foudah *et al*., in 2021 found that cilantro has less anti-oxidant property and high anti-inflammatory property. Now the result of this study also indicates that *Coriandrum sativum* homoeopathic tincture and plant extract has anti-oxidant property less than the standard ascorbic acid. But *Coriandrum sativum* homoeopathic has greater anti-inflammatory property than the Diclofenac sodium in lower concentration and not in higher concentrations. But when comparing the homoeopathic tincture and the plant extract of the *Coriandrum sativum*, *Coriandrum sativum* homoeopathic tincture showed greater anti-inflammatory activity.

According to the research conducted by Fehmida Ismail *et al*., 2025 found that *Coriandrum sativum* seed has more anti-oxidant property than seed. In this research too the homoeopathic tincture of *Coriandrum sativum* which is prepared from the seeds has higher anti-oxidant property when compared to the *Coriandrum sativum* plant extract.

As in this study, *Coriandrum sativum* homoeopathic mother tincture is found to have both antioxidant and anti-inflammatory properties we can recommend the usage of this mother tincture in various disease condition like cardiovascular diseases, rheumatoid arthritis, Type 2 diabetes mellitus, neurodegenerative condition, IBD etc.

Further studies on this homoeopathic medicine can be conducted by the drug proving of this medicine on the healthy provers and be made use in the day-to-day practice.

Conclusion

From the above in vitro study it is concluded that *Coriandrum sativum* Q has both antioxidant and anti-inflammatory property and can be further studied for the symptomatology of the medicine using drug proving on the healthy human beings. So, from this *Coriandrum sativum* Q can be prescribed in various inflammatory conditions like gastritis, rheumatoid arthritis, inflammatory bowel disease etc and it can also be used in various neurological

conditions like Parkinson's disease, Alzheimer's disease, multiple sclerosis etc since it has anti-oxidant activity.

Acknowledgement
I would like to express my thanks for the endless support, enlightening guidance and confidence instilled by my guide, Dr. Anandu N.R., MD (Hom), who motivated and whose wisdom continues to inspire me to this day.
I would like to thank my parents (Mr. S. Palanivel and Mrs. P. Vanaja Rani) and my brother (Mr. P. Manoj Babu) for being my pillar of support without them this project would have been difficult. I would like to extend my thanks to my senior (Dr. Keerthena. P) for helping me to getting through the difficult times.
I would like to extend my gratitude to Sarada Krishna Homoeopathic Medical College for helping me in conducting this study.

Financial support: Nil

Conflict of interest: Nil

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How to Cite This Article
Sunitha Devi P, Anandu NR. Comparison of antioxidant property and anti-inflammatory property of *Coriandrum sativum* crude extract and homoeopathic *Coriandrum sativum* q- *in vitro*. International Journal of Homoeopathic Sciences. 2025;9(3):960-964