

# Cultivating Health: A Comprehensive Study on Antimicrobial Activity and Phytochemical Composition of Coriander (*Coriandrum Sativum*) Seeds

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## ABSTRACT

The increasing rate of multi drug resistant pathogens and emergence of non-native pathogens, a quest for novel bioactive compounds has gained extensive attention. Plants have always been serving us as a potential source of bioactive metabolites further resulting in antimicrobial production which is of great use. *Coriandrum sativum*, commonly known as Coriander or Cilantro, has been celebrated for its culinary uses, adding a burst of flavor and flavor and aroma to dishes worldwide. Beyond its gastronomic delights, this herbaceous plant holds gem within its seeds- a treasure trove of antimicrobial compounds. *Coriandrum sativum* is one of those valuable plants that contain essential components known as ‘phytochemicals’ and microbe inhibiting property known as ‘antimicrobial property’. The present work is done to test whether *Coriandrum sativum* contains the phytochemicals and antimicrobial property or not. People consume it as remedy for various diseases like diarrhea, acidity, cholesterol, diabetes, UTI and many more.

The phytochemical analysis of the seeds the plant was carried out and it was revealed that they produce essential phytochemicals like tannin, flavonoid, saponin, phenol, steroid, carbohydrate etc. Chemicals like chloroform, Fehling’s solution, H<sub>2</sub>SO<sub>4</sub>, HCl etc. were used for the phytochemical tests. The antimicrobial activity of the plant against gram positive and gram-negative bacterial species *E. coli* were also observed. To test the antimicrobial property, two different solvents Methanol and Petroleum ether were added to seed extract of the plant. Well diffusion method was used for this. After the analysis, positive result was observed which was indicated by a zone of inhibition.

**Keywords:** Pathogens, bioactive, antimicrobial, metabolites, phytochemical, multi drug resistant

## INTRODUCTION

Throughout human history, nature has been a vast repository of medicinal treasures, providing remedies for countless ailments (C. Veeresham 2012). Among nature’s greatest healers stand the humble plants, which have played a pivotal role in the development of pharmacology and medicine. Plants have been a fundamental source of healing compounds for thousands of years and their vast biodiversity continues to captivate scientists and researchers in the pursuit of novel drug discovery (Fatima Morales et al. 2016). Plants have provided a source of inspiration for novel drug compounds as plant derived medicines have made significant contribution towards human health (Heng Zou et al. 2021). Plant derived antimicrobial

compounds have been found to be associated with enormous therapeutic potential because of their proven efficiency negligible or lesser side effects as compared to synthetic antimicrobials (Natalia Vaouet al. 2021). With evolving pathogens, their virulence and drug resistance, it is evident that new approaches are needed in no time to combat emerging infections and the global spread of drug resistant microbial pathogen.

The use of plants as medicines traces back to ancient civilizations, where indigenous people skillfully harnessed the therapeutic properties of various plant species. From ancient herbalists to modern pharmacologists, the quest to unlock nature's secrets for improving human health has persevered, leading to the identification of numerous life-saving compounds derived from plants. In most of the developing countries, about 80% of people rely on traditional medicines for primary health care and are seen to be using plants or plant extracts as bioactive substances in the treatment of various ailments. (Kim H-S 2005).

In recent years, with advances in technology and our understanding of molecular biology, the study of plants as a source of novel drugs has witnessed a renaissance. Scientists now have access to cutting-edge tools and techniques that enable them to explore the vast chemical diversity harbored within plant species. This reinvigorated interest in plant-based drug discovery arises from several compelling reasons.

Firstly, plants boast an unparalleled ability to synthesize a remarkable range of secondary metabolites, each with unique chemical structures and biological activities. These secondary metabolites, often produced as defence mechanisms against environmental stressors, pests, and diseases, have been found to possess remarkable therapeutic potential for humans (S.Pagare et al. 2015).

Secondly, the rise of drug-resistant pathogens and the continuous challenge of treating complex diseases like cancer have spurred a demand for new and innovative drugs ((Ashim K. Mitra et al. 2015). Plant-derived compounds, known for their diverse mechanisms of action, offer an opportunity to combat these challenges and open new avenues in drug development (C.Veerasham 2012).

In this exploration of plants as a source of novel drug discovery, we delve into the rich history of traditional medicine and its links to modern pharmacology. We examine the methodologies employed by researchers to identify, isolate, and characterize bioactive compounds from plants. Despite the strides made in this field, the vast majority of plant species remain untapped reservoirs of potential medicinal compounds. As we venture further into the realm of plant-based drug discovery, we must balance scientific curiosity with sustainable practices to preserve the delicate ecosystems that nurture these extraordinary botanical wonders.

The plant *Coriandrum sativum* (commonly known as Coriander can be considered as one of those plants with tremendous medicinal properties. The plant was originated in Italy and now cultivated almost all across the world. Though the herb contains all edible parts but the leaves and seeds are commonly used in cooking. (Manjeshwar Shrinath et al. 2015) . Besides its culinary purposes, seeds of Coriander are known to have outstanding medicinal properties and has been indigenously used in the treatment of disorders of the urinary, digestive and respiratory, as it has diaphoretic, diuretic, carminative, and stimulant effects (Pathak Nimish L et al. 2011). The plant is a herb and is an annual plant with height 30–100 cm and the leaves are branched, bright-green and the stem is erect (L.A. Shelef 2003). The roots are well developed tap root and the flowers are small white or pink in colour. Seeds are small oval and aromatic with longitudinal ridges.

## MEDICINAL VALUE OF CORIANDRUM SATIVUM

The plant shows outstanding medicinal importance because of the availability of bioactive phytochemical constituents present in both in seeds and leaves. Thus leaves and seeds of *Coriandrum sativum* are equally beneficial, however, the present study focuses on the seeds. Coriander is considered a medicinal plant as it can lower blood sugar level, ease digestive discomfort, decrease blood pressure, fight food poisoning, lower cholesterol levels, help urinary tract infections, support healthy menstrual function, prevent neurological inflammation & disease, protect against cardiovascular disease, prevent diabetes etc. (Lauren Panoff 2019). Coriander seeds and leaves are rich in vitamins and minerals. To date, the majority of phytochemical studies on *Coriandrum sativum* have focused on different types, like: tannin, flavonoid, carbohydrates, proteins, saponin and steroid. (Nithya V 2015). To withstand various biotic and abiotic stress, coriander, like other plants synthesizes secondary metabolites and coriander seeds are found to be rich in metabolites like essential oil (that contain limonene, camphor, linalool and geraniol), polyphenols, carotenoids, isocaumarins and also fatty acid. (Alev Önder 2018)

## MATERIALS AND METHODS

### Collection of the sample

Dried seeds of *Coriandrum sativum* were collected from local market in Guwahati. They were washed to minimize contamination and again dried under sun. They were grounded with the help of a mixer grinder and fine powder was prepared from the seeds. The powder was stored in an air tight container.

### Extract preparation

50 g of powdered form of *Coriandrum sativum* had been extracted in 500 mL boiling distilled water with two different solvents –methanol (70:30 : v/v and petroleum ether 60:40) using soxlet apparatus.



**Fig 1 : Extraction in Soxlet apparatus**

After extraction, it was evaporated in porcelain dish to obtain dried concentrated form of the extracts. It was stored at 4°C for the phytochemical analysis.



**Fig 2: Extract of methanol after evaporation**



**Fig 3: Extract of petroleum ether after evaporation**

### **PHYTOCHEMICAL ANALYSIS**

After successful extraction and evaporation, the resulted extract was subjected to different phytochemical tests to determine the presence of essential chemical components of plants like tannin, saponin, steroid, carbohydrates, alkaloids.

#### **Alkaloids**

Alkaloids are compounds that are biosynthetically derived from amino acids resulting in a wide variety of chemical structures, mostly isolated from plants (Verpoorte R 2005).

Mayer's test was carried out to test the presence of alkaloids. 1.2 ml extract was mixed with 0.1 ml Mayer's reagent and 0.2 ml dilute HCL was added to it.

#### **Carbohydrate**

Carbohydrates are probably the most abundant and widespread organic substances in nature, and they are essential constituents of all living things. Carbohydrates are formed by green plants from carbon dioxide and water during the process of photosynthesis. Molish test was carried out to test the presence of carbohydrate. 10% alpha naphthol was mixed with the extract and shaken. Few drops of concentrated  $H_2SO_4$  was added to it. Fehling's test was also carried out to detect the presence of carbohydrate. For the Fehling's test, 2ml of Fehling A and B solutions were mixed with 2ml extract.

#### **Protein**

Proteins are large biomolecules, or macromolecules, consisting of one or more long chains of amino acid residues. To test the presence of protein, xanthoproteic test was carried out where conc.  $HNO_3$  was added to the extract.

#### **Flavonoid**

Flavonoids are a diverse group of phytonutrients (plant chemicals) found in almost all fruits and vegetables. Along with carotenoids, they are responsible for the vivid colors in fruits and vegetables (**M Sadiq** 2022). For testing the presence of flavonoid, few drops of dilute NaOH was added to 1ml of extract.

#### **Steroid**

Steroids have two principal biological functions: as important components of cell membranes which alter membrane fluidity; and as signaling molecules. The presence of steroid is determined by mixing 2ml of extract with 2ml of chloroform and adding few drops of dilute  $H_2SO_4$ .

#### **Tannin**

They are class of secondary metabolites that is bitter in taste and are significant deterrents to herbivores. For testing the presence of tannin, 1% HCL was added to the extract and it was boiled.

## Saponin

Saponins are a class of chemical compounds found in particular abundance in various plant species. For testing the presence of saponin, 2ml NaOH was added to 2ml extract.

## ANTIMICROBIAL ASSAY

The antimicrobial properties of plants have been recognized for centuries and continue to be of significant interest in modern scientific research. Plants produce a diverse array of bioactive compounds as part of their natural defence mechanisms against various pathogens (MM Cowan 1999). These compounds possess the ability to inhibit the growth and survival of microorganisms, including bacteria, fungi, and viruses. Harnessing the antimicrobial potential of plants offers a promising avenue for developing alternative and sustainable solutions to combat infections and microbial resistance. In this context, investigating the antimicrobial properties of plants, such as *Coriandrum sativum* seeds, holds the potential to uncover novel therapeutic agents for a range of applications, from healthcare to food preservation.

## MEDIA PREPARATION

36 g of Muller Hinton Media was mixed with distilled water and then sterilized in autoclave at 15 lb pressure for 15 minutes. The sterilized plates were bored with cork borer. Wells were made in the plates and used for the antibacterial studies.

## WELL-DIFFUSION METHOD

Antimicrobial activities of the seeds of *Coriandrum sativum* was tested using well-diffusion method. The prepared culture plates were inoculated with strain of *E.coli* using spread plate method. Wells were made on the agar surface using cork borer. The extracts were poured into the wells using micro pipette. The plates were incubated at 37°C for 24 hours for bacterial activity. The plates were observed for the zone of inhibition around the wells.

## ANTIMICROBIAL SCREENING TESTS

The sensitivity of the isolated and sub-culture test organism to the different extracts of *C.sativum* seeds was carried out using the well-diffusion method. The plates of MH (Muller-Hinton) medium were prepared and 200 microlitre of culture broth of *E.coli* was inoculated on this plates by spread plate technique by using sterile spreader. Holes were made in the seeded agar using sterile cork borer. The extracts obtained was introduced into each holes on the medium and allowed to stand on the bench for one hour for proper diffusion, and thereafter incubated at 37°C for 24 hours.

## OBSERVATIONS AND RESULTS

### RESULTS OF PHYTOCHEMICAL TEST

#### PHYTOCHEMICAL TEST RESULTS OF METHANOLIC EXTRACT

Table : 1

TEST		OBSERVATION	RESULT
ALKALOIDS	Mayer's test	The colour of the extract changed into yellow.	Positive
CARBOHYDRATE	Molish test	A violet ring was observed at the	Positive

		junction of the two liquids.	
REDUCING SUGARS	Fehling's test	A brick red precipitate was observed at the bottom of the tube.	Positive
PROTIEN		The colour of the extract did not changed to yellow	Ngative
FLAVONOID		An intense yellow colour was observed.	Positive
STEROID		The colour of the extract changes into reddish brown	Positive
TANNIN		Deposition of red precipitate was seen at the bottom of the tube.	Positive
PHENOL		The colour of the extract becomes green.	Positive
SAPONIN		The colour of the extract changes to yellow.	Positive

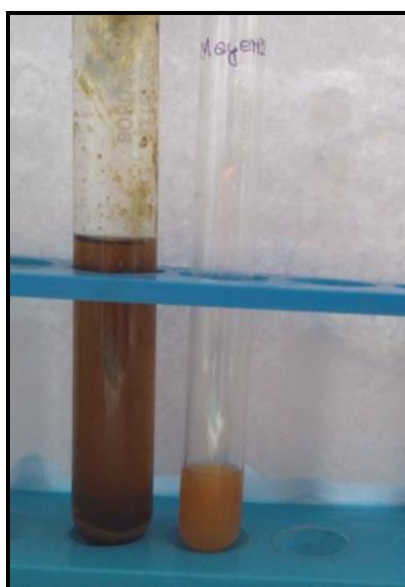
**PHYTOCHEMICAL TEST RESULTS OF PETROEUM ETHER EXTRACT**
**Table : 2**

TEST		OBSERVATION	RESULT
ALKALOIDS	Mayer's test	The colour of the extract did not change into yellow.	Negative
CARBOHYDRATE	Molish test	A violet ring was not observed at the junction of the two liquids.	Negative
REDUCING SUGARS	Fehling's test	A brick red precipitate was not observed at the bottom of the tube.	Negative
PROTIEN		The colour of the extract did not change into yellow	Negative
FLAVONOID		An intense yellow colour was not observed.	Negative
STEROID		The colour of the extract changes into reddish brown	Positive
TANNIN		Deposition of red precipitate was not seen at the bottom of the tube.	Negative
PHENOL		The colour of the extract becomes green.	Positive
SAPONIN		The colour of the extract changes to yellow.	Positive

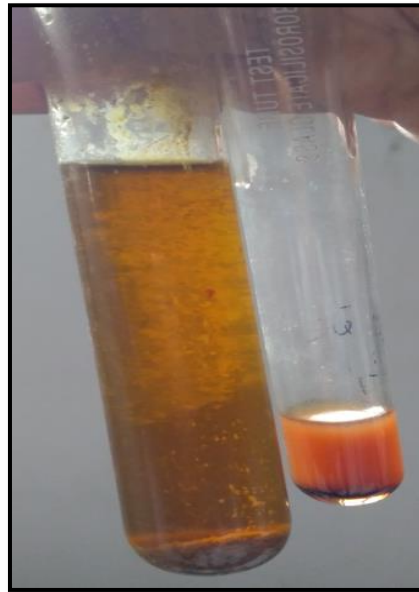
**PHYTOCHEMICAL TESTS RESULTS OF WATER EXTRACT**

**Table : 3**

TEST		OBSERVATION	RESULT
ALKALOIDS	Mayer's test	The colour of the extract did not change into yellow.	Negative
CARBOHYDRATE	Molish test	A violet ring was observed at the junction of the two liquids.	Positive
REDUCING SUGARS	Fehling's test	A brick red precipitate was observed at the bottom of the tube.	Positive
PROTIEN		The colour of the extract did not change into yellow	Negative
FLAVONOID		An intense yellow colour was observed.	Positive
TEROID		The colour of the extract changes into reddish brown	Positive
TANNIN		Deposition of red precipitate was not seen at the bottom of the tube.	Negative
PHENOL		The colour of the extract did not become green.	sNegative
SAPONIN		The colour of the extract changes to yellow.	Positive



**Fig 4 : Alkaloids (Mayer's test)**



**Fig 5 :Carbohydrate (Molish) test**

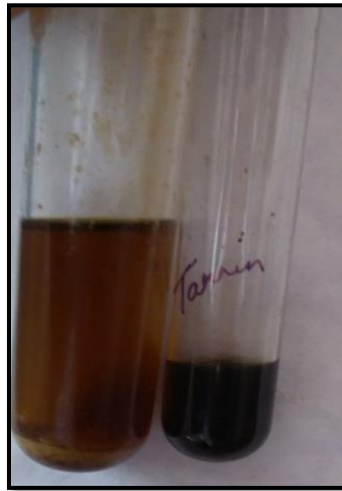


**Fig 6:Carbohydrate (Fehling's test)**

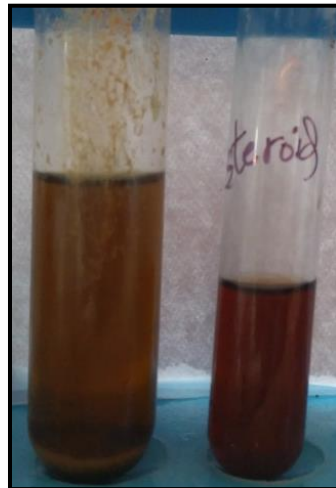


**Fig 7: Flavonoid test**





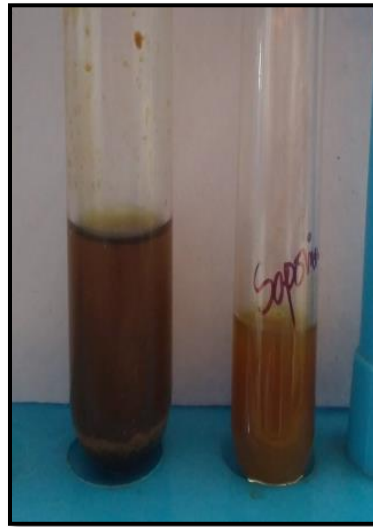
**Fig 8: Steroid test**



**Fig 9 : Tannin test**



**Fig 10 : Phenol test**



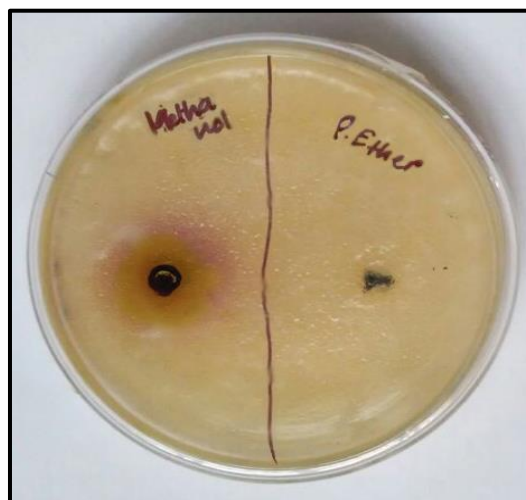
**Fig 11 : Saponin test**

**ANTIMICROBIAL ACTIVITY TEST RESULTS :**

The antimicrobial activity of the seeds of *Coriandrum sativum* against *E.coli* was demonstrated by the zone of inhibition around methanolic, petroleum ether and water extract in the culture plates. The maximum zone of inhibition was seen around the well containing methanolic extract. The diameters of the zone of inhibition shown by different extracts are tabulated below :

**Table : 4**

EXTRACT	DIAMETER OF ZONE OF INHIBITION
Methanol	19 mm
Petroleum ether	No zone
Water	13 mm



**Fig 12 : Zones of inhibition for Methanol extract (left), Petroleum ether extract (right)**



**Fig 13: Zone of inhibition for Aqueous extract**

## DISCUSSION

The present work was conducted to carry out the Phytochemical analysis of the selected plant *Coriandrum sativum* to find out whether it contains essential phytochemicals or not. In addition, antimicrobial property of the seeds of *Coriandrum sativum* was determined by carrying out antimicrobial testing by visualizing the zone of inhibitions for different extracts of *Coriandrum sativum* seeds – Methanol, Petroleum ether and water.

## PHYTOCHEMICAL TESTS

After the phytochemical analysis, the seeds of *Coriandrum sativum* were found to contain essential phytochemicals like alkaloids, carbohydrate, reducing sugars, steroid, flavonoid, steroid, tannin, phenol and saponin which showed positive results for methanolic extract. Presence of only phenol, saponin and steroid were seen for petroleum ether extract . Presence of saponin, reducing sugars , flavonoid, steroid and carbohydrate showed positive results for water extract.

Thus, it can be concluded that the methanolic extract of *Coriandrum sativum* was most efficient in demonstrating the essential phytochemicals.

## ANTIMICROBIAL ACTIVITY

The antimicrobial activity of *Coriandrum sativum* is one of its essential properties which helps to inhibit the growth of disease causing microbes. Analysis of antimicrobial activity of the seeds of *Coriandrum sativum* was done by taking *E.coli* as the test organism. The different extracts of the seeds – methanol, petroleum ether and water extracts were used for the assay. Finally, it was noticed that the seeds of *Coriandrum sativum* were capable to show its antimicrobial activity against *E.coli* which was indicated by a zone of inhibition. However, the diameter of the zone of inhibition was maximum for methanolic extract because methanol was able to extract all the polar components present in the plant. No zone of inhibition was seen for petroleum ether extract.

## CONCLUSION

In conclusion, the study of the antimicrobial properties of plants, including *Coriandrum sativum* seeds, underscores the remarkable potential of natural sources in addressing the growing challenges of microbial infections and resistance ( Ali BH 2003) . The intricate chemical compositions of these plants

have evolved over time to provide a defense mechanism that offers an alternative to conventional antimicrobial agents (Calo JR et al. 2015). The research presented here highlights the significance of harnessing the bioactive compounds found in plants for various applications, ranging from pharmaceuticals to agricultural practices. As microbial resistance continues to pose a global threat, the exploration of plant-based antimicrobial agents opens doors to innovative solutions that can contribute to more sustainable and effective approaches in combatting infections. Further studies in this area hold promise for expanding our understanding of the intricate interplay between plants and microorganisms, ultimately leading to the development of novel therapeutic strategies with broader implications for human health and wellbeing.

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