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An experimental study of cumin and it's dilutions

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Abstract

Background: *Cuminum cyminum* (cumin) has been used for medicinal purposes since ancient times, particularly in the management of digestive disorders. Despite its long-standing therapeutic use, limited attention has been given to the identification of nanoparticles in its higher homoeopathic dilutions using modern analytical techniques.

Objective: The present study aimed to synthesize and identify nanoparticles from *Cuminum cyminum* primary tincture and its higher dilutions (1X, 2X, and 3X) using chemical methods and dynamization, followed by spectroscopic characterization.

Methodology: Nanoparticle synthesis was carried out using potassium ferricyanide as a biocatalyst. The primary tincture and its successive dilutions (1X, 2X, and 3X) were prepared through standard procedures involving dynamization. The samples were analyzed using: UV-Visible Spectroscopy, Fourier Transform Infrared (FTIR) Spectroscopy, Scanning Electron Microscopy (SEM)

Results: The presence of nanoparticles in the primary tincture and its dilutions (1X, 2X, and 3X) was successfully identified. UV spectroscopy revealed characteristic absorbance peaks, while FTIR confirmed the presence of functional groups corresponding to cumin constituents. SEM analysis further supported the presence of nanoscale particles in all tested potencies.

Conclusion: The findings suggest that nanoparticles of *Cuminum cyminum* can be detected even in higher dilutions. Modern analytical tools such as UV spectroscopy, FTIR, and SEM can serve as effective techniques for identifying physicochemical properties in homoeopathic preparations. This study opens avenues for further investigation into nanoparticle characterization in potentized medicines.

Keywords: FTIR, UV, Cumaldehyde, polyphenols

Introduction

Cumin, scientifically known as *Cuminum cyminum*, is a cherished spice that originates from an annual plant in the Apiaceae family, which includes parsley. It's primarily recognized for its distinct flavor, making it a staple in various cuisines, particularly in regions around the Mediterranean. Additionally, cumin is cultivated in countries like China, Mexico, and India. This plant typically grows to a height of about 50 cm (20 inches) and showcases delicate, finely divided leaves. The leaf structure varies, with feathery shapes adorning the flowering stalks and more lobed designs towards the plant's base. Cumin produces small, asymmetrical flower clusters, known as umbels, which bloom in either white or very pale pink. Notably, the outer petals of the umbel are longer (5-6 mm) compared to the inner petals (1-3 mm). The fruit of the plant is a dry, round schizocarp with a diameter of 3-5 mm, while its pollen measures around 30 µm. Characterized by its slender, herbaceous nature, the cumin plant features distinctive blooms that form flat-topped umbel clusters. The seeds, or rather the dried fruits called schizocarps, are long, oval, and thin, presenting a yellowish-brown hue. Each measures about 6 mm (0.25 in) and is marked by a grid-like pattern formed by five prominent ridges along with secondary, less obvious ridges. The primary component of the essential oil, which ranges from 2.5-4.5 percent, is cumaldehyde. Herbs and spices, including cumin, are plant parts valued for their aromatic properties and flavor. They can be derived from various plant components such as rhizomes, bulbs, bark, flower buds, stigmas, fruits, seeds, and leaves. Generally, they are categorized into three main groups: herbs, spices, and spice seeds. The spice seeds, such as those from herbaceous plants like sesame and anise, along with cumin and fennel, are tiny, fragrant fruits known for their culinary contributions.

In contrast, the aromatic leaves from plants like marjoram, mint, rosemary, bay leaf, parsley, and thyme, can be enjoyed fresh or dried. Whether enhancing flavor, aroma, or piquancy, herbs and spices play an essential role in cooking. Beyond their culinary uses, herbs and spices have a long history in traditional medicine, particularly in regions like China and India. While their medicinal applications may be more limited in Western countries, there is a growing interest in their healing properties, reigniting attention towards herbal and alternative remedies since the late 20th century ^[1].

Linalool is the key component that gives coriander its distinctive flavor and aroma. This compound is part of the mixed polyphenols and terpenes found in coriander's essential oil, which is derived from both its leaves and seeds. The taste of coriander can be quite subjective; some people find its flavor and smell appealing, describing it as refreshing and citrusy, while others have a strong aversion, likening it to soap or even decay. Studies show that preferences for coriander can vary significantly among different cultural groups. When it comes to Visible UV Spectroscopy, this technique is essential for gathering vital synthetic data across various cutting-edge fields. The UV/VIS spectrophotometer is a highly adaptable research tool that can be obtained in diverse optical configurations, specifications, wavelength ranges, and functionalities, often at an affordable price. While it's crucial for the instrument to be robust, it also requires a deep understanding from the user to ensure it fits the specific scientific project and operates correctly. In conducting UV/VIS analyses with a certified spectrophotometer, researchers sometimes express concern over data consistency and its implications. This raises an important question in UV/VIS studies: are different spectrophotometers capable of producing comparable measurement results? From a quality control perspective, it's essential to ask, "Will I achieve the same measurement data if I use a different UV/VIS spectrophotometer?" The most reliable way to address this and establish foundational evidence is through reference material normalization. The established lab standard operating procedure, often referred to as the validation/qualification protocol, hinges on reference material normalization. This should include a rigorous evaluation of the spectrophotometer's wavelength accuracy and photometric performance, along with an assessment of stray light levels ^[1].

Materials and Methods

Preparation and UV-Visible Spectrophotometric Analysis of *Cuminum cyminum* Mother Tincture

Collection and Preparation of Raw Drug

Whole cumin seeds (*Cuminum cyminum*) were procured from the local market. The seeds were dried properly and then ground into fine powder using a clean metal mortar and pestle.

Type of Study

Experimental Study

Duration of Study

2 Weeks

Sites of Study

1. Jawaharlal Nehru Homoeopathic Medical College

2. Parul Institute of Homoeopathic Research, Parul University, Vadodara, Gujarat, India

Tool Used

UV-Visible Spectrophotometer-1900 Series

Model: UV 1900i (A12536082607)

Type: Double Beam

Medicinal Substance

Cuminum cyminum Mother Tincture

Materials Used

1. Beaker (50 mL capacity)
2. Measuring cylinder (100 mL capacity)
3. Pipette
4. Funnel
5. Mortar and Pestle
6. Whatman filter paper
7. Hard glass bottle

Drug and Vehicle Ratio

1: 99 (Drug: Absolute Alcohol)

Procedure

Preparation of Tincture

The formulation was prepared using standard *Cuminum cyminum* powder and absolute alcohol in a ratio of 1:99.

Maceration Process

One part of finely powdered cumin was taken in a clean beaker.

Ninety-nine parts of absolute alcohol were added using a pipette.

The beaker was sealed properly and kept undisturbed for 15 days for maceration.

Filtration

After 15 days, the mixture was filtered using Whatman filter paper.

Labelling

The prepared mother tincture was transferred into a hard glass bottle and labeled with the following details:

Name of the drug

Quantity of drug

Name and quantity of vehicle

Drug and vehicle ratio

Date of preparation

Caution

Storage

The prepared formulation was stored in a cool, dark place in a hard glass bottle, protected from sunlight, moisture, and strong-smelling substances.

Spectrophotometric Analysis

The prepared samples were divided into two groups:

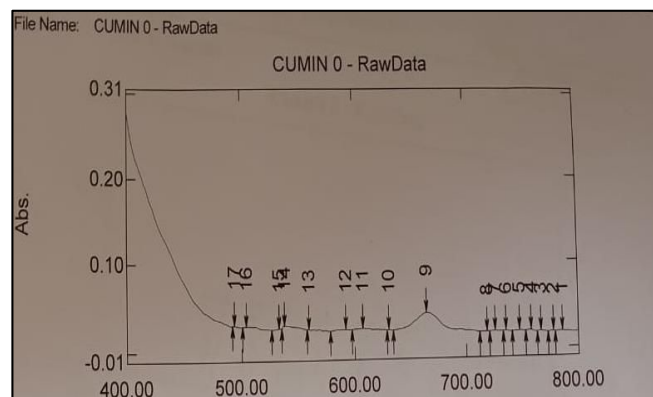
Alcohol (Blank)

Main Sample (Mother Tincture)

Both samples were analyzed using a double-beam UV-Visible spectrophotometer within a wavelength range of 300-700 nm.

Results

The UV-Visible spectrophotometric analysis was performed for both the blank (alcohol) and the prepared mother tincture sample. The absorbance values were recorded across the wavelength range of 300-700 nm for comparative evaluation [2].



Graph 1: CUMIN 0 – Raw Data

Table 1: Shows that significant UV-Visible absorbance was observed in the wavelength range of 490-608 nm.

No.	P/V	Wavelength (nm)	Abs.	Description
11	↑	608.00	0.0260	
12	↑	592.00	0.0249	
13	↑	559.50	0.0257	
14	↑	538.00	0.0300	
15	↑	533.00	0.0269	
16	↑	503.50	0.0297	
17	↑	493.50	0.0306	
18	↓	780.00	0.0176	
19	↓	773.50	0.0170	
20	↓	764.00	0.0178	
21	↓	753.00	0.0187	
22	↓	741.00	0.0184	

Absorption in this region (visible green-yellow region of the spectrum) suggests the presence of specific phytochemical constituents of *Cuminum cyminum*.

Possible Phytochemical Contributors

Oxidized Cuminaldehyde Derivatives

Cuminaldehyde is a major constituent of cumin essential oil. Upon oxidation, its derivatives may exhibit absorbance in the visible region due to extended conjugation.

Phenolic Compounds: Hydroxybenzoic acids, Hydroxycinnamic acids, Flavonoids. Many flavonoids and phenolic acids possess conjugated double-bond systems that allow absorption in the visible range, particularly in the green-yellow region (approximately 500-600 nm).

Tannin Derivatives: Complex tannin structures may also contribute to absorbance in this region due to their polyphenolic nature.

Carotenoids and Pigment Derivatives

Although present in modest concentrations, pigment breakdown products in mother tinctures can absorb light in the 500-600 nm range. Carotenoid derivatives, owing to their highly conjugated structures, are known to exhibit such absorption.

Metal-Phenolic Complexes

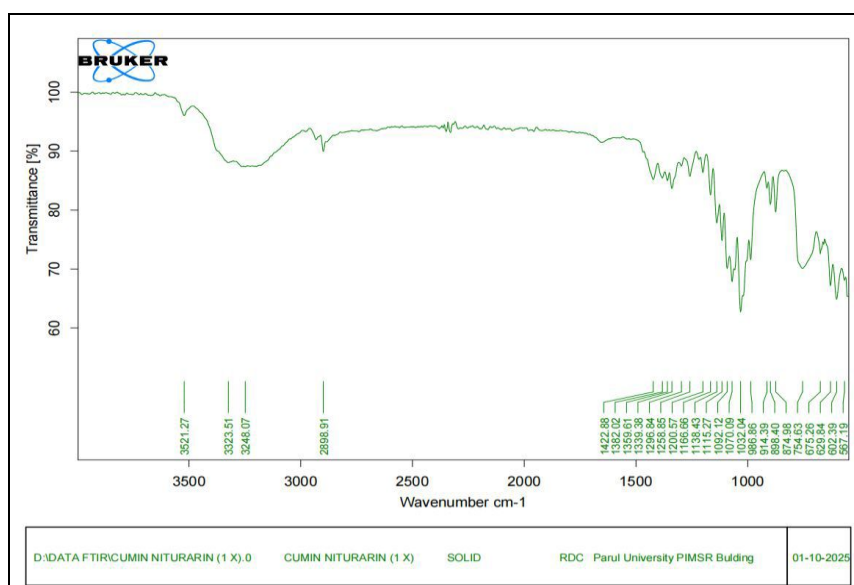
If the mother tincture interacted with trace metals during preparation or storage, complex formation between phenolic compounds and metal ions may occur. Such complexes can show absorbance near 590 nm, similar to observations reported in plant-mediated nanoparticle synthesis studies [3, 4].

Interpretation

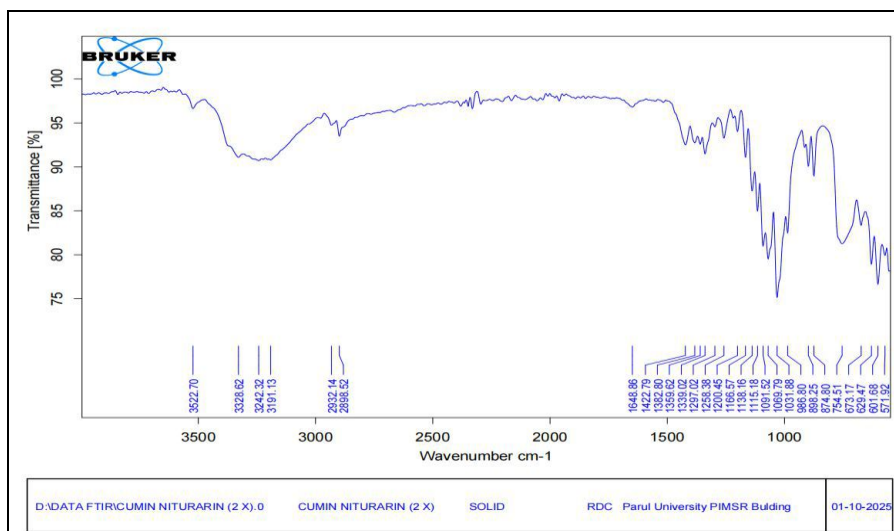
The absorbance peak observed between 490-608 nm confirms the presence of conjugated phytochemical constituents in the mother tincture of *Cuminum cyminum*. The spectral characteristics support the presence of phenolic compounds, flavonoids, oxidized aldehyde derivatives, and possible metal-complexed compounds.5

These findings further strengthen the evidence obtained from FTIR and SEM analyses, indicating the retention of bioactive constituents in the prepared formulation.6

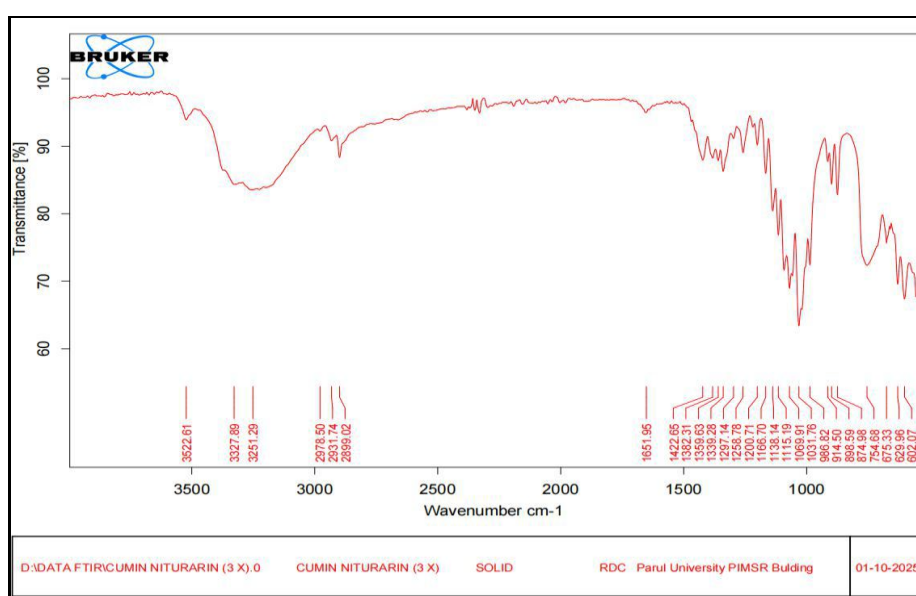
FTIR



Graph 2: Cumin 1x-



Graph-3: Cumin 2x



Graph 4: Cumin 3x-

C-H stretching vibrations, mainly arising from aliphatic hydrocarbons, are typically observed in the range of 3000-2800 cm⁻¹ in Fourier Transform Infrared (FTIR) spectroscopy [7].

In the present study, a characteristic absorption peak observed between 2898-2923 cm⁻¹ in cumin seeds and cumin oil indicates the presence of:

Lipids and Fats

The CH₂ and CH₃ functional groups present in fatty acids exhibit symmetric and asymmetric C-H stretching vibrations. These are commonly found in cumin oil [8].

Essential Oil Components (Terpenes)

The principal constituents of cumin essential oil contain alkyl chains that show characteristic C-H stretching vibrations in this region [9].

Thus, the observed FTIR peaks confirm the presence of lipidic and terpene components in the prepared samples.

Results

Nanoparticles of *Cuminum cyminum* Primary Tincture, 1X, 2X, and 3X potencies were identified using:

Scanning Electron Microscopy (SEM)

Fourier Transform Infrared (FTIR) Spectroscopy

The SEM analysis confirmed the presence of nanoparticles in different potencies, while FTIR spectra showed characteristic functional group peaks corresponding to cumin constituents [10].

Conclusion

Based on SEM and FTIR analysis, it can be concluded that particles of *Cuminum cyminum* can be identified even at higher dilutions (1X, 2X, and 3X potencies). The presence of characteristic functional groups supports the retention of source material properties across dilutions.

Conflict of Interest

The authors declare that there is no conflict of interest.

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