Preliminary study on phytochemical, phenolic content, flavonoids and antioxidant activity of Coriandrum Sativum L. originating in Vietnam

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Abstract. In recent times, advances in the health views of many micronutrients, such as carotenoids, flavonoids, anthocyanins, phenolics, minerals, and molecular-level vitamins have opened a new horizon in the nutrition field. In Vietnam, spice vegetables have long been popularly used in daily meals, increasing the sense of taste of the food as well as taking advantage of the therapeutic properties that are beneficial to their health. Among them, Coriandrum sativum L. is most commonly used because of its attractive aroma and medicinal potential. These vegetable have anti-inflammatory, hypoglycemic, and alleviated gastrointestinal tract problems, and they also show significant cancer-fighting potential. In this research, the leaf extract of Coriandrum sativum L. was tested for preliminary qualitative phytochemical composition, assessing phenolic content by the Folin-Ciocalteu method, flavonoid by aluminum chloride method and activity oxidation resistance (DPPH-2, 2-diphenyl-1-picrylhydrazyl). The results illustrated that the presence of components such as tannins, and saponin. Besides, the total phenolic and flavonoid content were determined as 113.08 mgGAE/g DW and 72.64 mg QE/g DW, respectively. The antioxidant activity obtained with IC50 value were 78.309 ug/ml (DPPH) and 54.489 ug/ml (ABTS). This result shows the effectiveness of Coriandrum sativum L. in increasing antioxidant foods in daily meals.

1. Introduction
Numerous therapeutic agents have been discovered in medicinal plants today [1]. Medicinal plants play a significant role in traditional medicine and are listed in pharmacopoeia worldwide [2]. Coriandrum sativum L. is a seasoning herb as well as the Apiaceae family that is grown year-round originating from the Mediterranean and southern Europe. It is a unique plant that can both be spices and capable of making herbs [3]. Coriandrum sativum L. is widely applied both traditionally and in modern medicine because of its various nutritional and medicinal benefits based on its inherent medicinal properties. In traditional medicine, Sativum Coriandrum L. is used as a pharmaceutical drug to diagnose intestinal, respiratory and urinary disorders. In addition, it is also known as an antispasmodic, anti-inflammatory,
ligation, analgesic and antiseptic [4]–[10]. Previous studies have shown that Coriandrum sativum L. has nutritional components such as water, protein, fat, fiber, ash, minerals, sugar and essential oils [11],[12]. Besides the nutritional values, the antioxidant properties of Coriandrum sativum L. also have many useful applications for humans in addition to using them as a spice. It can be applied as a strong antioxidant to improve food preservation [13]–[20]. Diseases like dementia, diabetes, inflammation, atherosclerosis, or cancer all stem from aging and the effects of industrialization in all aspects of human life, due to the action by reactive oxygen spicies (ROS). Coriandrum sativum L can thus help reduce oxygen stress and wake up the body's antioxidant system, protecting the body from ROS attack [15-17], [21-24].

The aim of this analysis is to preliminary assessment of the physical and chemical composition of Coriandrum sativum L. Phytochemical analysis showed that plants have different biological activities such as alkaloids, terpenes, tannins, saponins. In addition, this report provides research on the antioxidant activity of this plant more clearly. In addition, this report provides more precise study of the total polyphenol, flavonoid and antioxidant activity of this plant. The results may be a source of data on Coriandrum sativum's potential as a source of raw material for more application of phenolic ingredients.

2. Materials and method

Coriandrum sativum L. samples were bought at An Phu Dong Ward market, District 12, HCMC. Ho Chi Minh City from December 2019 to February 2020. Raw materials are processed in the laboratory of applied materials science under the Nguyen Tat Thanh University Institute of High Technology. Raw materials are removed roots, washed mud and dried then drained and dried at 60°C. The final product is pulverized and stored in a sealed zip bag that has been removed from moisture.

![Figure 1. Raw materials Coriandrum sativum L. a) before grinding and b) after processing and pulverizing](image)

2.1. Extraction process

10g of powdered raw material is extracted in turn with two different solvents, ethanol 96% and distilled water for 1 hour at 70°C with stirring speed of 300rpm. The extract is then filtered and concentrated by rotary evaporator at 40-50°C. Dried medicinal herbs were stored at 4°C until they were used for experiments.

2.2. Phytochemical Analysis

Phytochemical analysis of ethanol 96% and water extract was done for presence/absence of metabolites such as flavonoids, alkaloids, tannin, terpenoids, saponins, anthraquinone, coumarin and reduce sugar [13]. Alkaloid test with Mayer, Bouchardat, Dragendorff test. Flavonoid test with H2SO4 and Wilstatter test. Testing anthraquinones and tannins with color transfer reaction. Coumarin test with fluorescence
reaction. Terpenoid test with Liebermann - Burchard and Salkowski test. Saponin test with foam test. Sugar reduction test with precipitation test.

2.3. Total Flavonoid Content

The method was conducted based on the method of Kamel Msaada et al [25]. Proceed to dilute the solution to the appropriate concentration (the solution obtained in the sample extract). Draw 0.5 ml of diluted sample solution into a test tube, then added 0.1 ml of 10% AlCl₃ solution. Continue to added 0.1 ml of CH₃COOK 1M solution and 4.3ml of distilled water, shaked well. Leave the solution at room temperature for 30 minutes. Then measured the optical absorbance at 415nm on the UV-Vis spectrophotometer. Quercetin was used as a standard. The TFC was shown in micrograms of quercetin equivalent in 1 mg of extract (mg QE/g extract).

2.4. Total Phenolic Content

Proceed to dilute the solution to the appropriate concentration (the solution obtained in the sample extract). Then suck 0.5 ml of diluted sample solution into a test tube. Add 2.5ml of 10% Folin-Ciocalteu solution and homogenize using a Vortex machine, leave the solution to react for 5 minutes. Continue, add 2.0 ml of Na₂CO₃ solution 7.5% and shake well. Leave the solution at RT for 1 hour in dark. The optical absorbance was then measured at 765 nm on the UV-Vis spectrophotometer. Standard gallic acid was used. The polyphenol content was expressed in micrograms of gallic acid equivalent in 1 mg of extract (mg GAE/mg of extract).

2.5. Antioxidant Activity

2.5.1. DPPH scavenging activity. The method was conducted based on the method of Helle Wangensteen et al. [14]. Dilute the dried sample to a suitable concentration level, suck 0.5 ml of diluted dry sample into a test tube. Control sample instead of ethanol extract (99.5%). Then, add a tube of 1.5 ml DPPH solution (OD517 nm = 1.1 ± 0.02) to a test tube and leave in the dark for 30 minutes. Measure optical absorbance at 517nm on UV-Vis spectrophotometer. Vitamin C (ascorbic acid) was applied as the reference standard. The percent DPPH scavenging effect was calculated as follows:

\[
\text{DPPH scavenging activity (\%)} = \frac{A_{\text{control}} - A_{\text{sample}}}{A_{\text{control}}} \times 100
\]

The result is expressed as IC₅₀, which shows the concentration of the sample needed to wipe out 50% of free radicals of DPPH solution.

2.5.2. ABTS scavenging activity. ABTS scavenging activity was calculated according to a protocol mentioned before [24]. Free radical solution ABTS Adjust the absorbance of the solution at a wavelength of 734 nm to 1,1 ± 02. Dilute the dried sample to a suitable concentration level, suck 0.5 ml of diluted dry sample into a test tube. Control sample instead of ethanol extract (99.5%). Afterwards, add 1.5ml ABTS solution (OD517 nm = 1.1 ± 0.02) to a test tube and place in the dark for 30 minutes. Measure optical absorbance at 734nm on UV-Vis spectrophotometer.

\[
\text{ABTS scavenging activity (\%)} = \frac{A_{\text{control}} - A_{\text{sample}}}{A_{\text{control}}} \times 100
\]

The result is expressed as IC₅₀, which shows the concentration of the sample needed to wipe out 50% of free radicals of ABTS solution.
3. Results and discussion

3.1. Analysis of chemical components

The results of plant qualitative screening of *Coriandrum sativum* L. are presented in Table 1. After conducting eight plant screening tests, *C. sativum* showed the presence of almost all components in various solvent extracts, including ethanolic extract (EE) and water extract (AE). For EE, the results showed the presence of alkaloid (in all three methods), tannin, flavonoid (in both methods), terpenoid (in Liebermann-Burchard method), coumarin and reducing sugar. At the same time, anthraquinones and saponin were not detected in this test. Evaluation results on water-based solvent extracts showed positive results for alkaloid (in all three methods), tannin, flavonoid (in both methods), terpenoid (in Liebermann-Burchard method), saponin and reducing sugar. Besides, both extracts share flavonoids and polyphenols in a simplified way, which are of interest because they show their exploitable biological properties.

Table 1. Analysis of chemical components of *Coriandrum sativum* L. extracts

| Class of compound            | Alcohol extract | Aqueous extract |
|------------------------------|----------------|-----------------|
| Alkaloid (Mayer’s method)    | +              | +               |
| Alkaloid (Bouchardat’s method)| +             | +               |
| Alkaloid (Drangendorf’s method)| -            | -               |
| Tannin                       | +              | +               |
| Anthraquinone                | -              | Reaction not perform |
| Flavonoid (Wilstatter’s method)| +            | +               |
| Flavonoid (H₂SO₄ method)     | +              | +               |
| Terpenoid (Liebermann – Burchard’s method)| + | + |
| Terpenoid (Salkowski’s method)| -            | -               |
| Coumarin                     | +              | -               |
| Saponin                      | -              | +               |
| Reducing sugars              | +              | +               |

3.2. TPC and TFC in different extract part

Table 2 shows the levels of phenolic compounds in AE and EE extracts from *Coriandrum sativum* L. In which, the total polyphenol content from ethanolic extract shows high content (113.08 mg GAE/g) compared to aqueous extract (75.72 mg GAE/g). For *Coriandrum sativum* L. in Tunisia and Canada extracted with methanolic, the total polyphenol content reached 12.10 mg GAE/g and 15.16 mg GAE/g, respectively [8]. In parallel, the total flavonoids content, the compound considered as one of the secondary plant metabolites, demonstrates the effectiveness of biological roles such as inhibiting plasma platelet aggregation, histamine release, and antiviral [6]. In an extract of *Coriandrum sativum* L. with ethanolic, total flavonoid content achieved the highest content (72.64 mg QE/g) compared to 39.12 mg QE/g of AE. Previous research has shown that the *Coriandrum sativum* L. extract showed a significant change in phenolic content in the same extract using different polar solvents. In addition, differences in phenol, flavonoid content may be due to genetic characteristics of each variety and other influencing factors such as farming conditions, or the level of irrigation and use of chemicals to support growth [7]. This shows that the choice of solvent when extracting is necessary to preserve the total active content in plants.
Table 2. TPC and TFC and antioxidant activities (IC50 values) of Coriandrum sativum L. extract

| Sample          | TPC (mg GAE/g) | TFC (mg QE/g) | IC50 value (µg/mL) | DPPH | ABTS |
|-----------------|---------------|---------------|--------------------|------|------|
| Ethanolic extract | 113.08        | 72.64         | 78.309             | 54.489 |
| Aqueous extract  | 75.72         | 39.12         | 108.233            | 97.368 |
| Ascorbic acid    | -             | -             | 3.05               | 2.51  |

3.3. DPPH radical-scavenging activity of C. sativum extracts

The DPPH method with an organic radical, 1,1-diphenyl-2-picrylhydrazyl is applied to determine the free radical scavenging activity and is expressed by IC50, which is interpreted as the amount of antioxidants needed to reduce the initial DPPH concentration to 50%. The antioxidant activity of a substance is called high when its IC50 value is lower. Coriandrum sativum L. has an advantageous flower antioxidant profile including radical free radical scavenging activity, phospholipid peroxide inhibition, chelation activity, hydroxyl radical and peroxidid peroxidation scavenging [7]. The antioxidant activity of the Coriandrum sativum L. extract determined by the DPPH method is shown in Figure 2. Specifically, the lowest IC50 is expressed in EE (78,309 µg/mL) while it is 108,233 µg/mL at AE. Besides, ABTS root removal is determined by observing color change at 734nm wavelength. Figure 3 illustrates ABTS's thorough scavenging ability in the EE and AE sections of Coriandrum sativum L. leaves. The similarity with the DPPH assay is shown in EE at 54,489 µg/mL and AE at 97,368 µg/mL. The results showed that extracted from Coriandrum sativum L with ethanolic extract for high antioxidant activity.

Figure 2. DPPH from Coriandrum sativum L.; a) ethanolic extract, b) water extract and c) ascorbic acid.
Figure 3. ABTS from Coriandrum sativum L.; a) ethanolic extract, b) water extract and c) ascorbic acid.

4. Conclusion
Current research has reported on TPC, TFC and evaluation of the antioxidant activity of Coriandrum sativum L. extracts. Reducing sugar is detected in the Coriandrum sativum L. extract. The findings indicate that they had a varied range of pharmacologically active compounds, including alkaloid, tannin, flavonoid, terpenoid, coumarin. Moreover, the analysis showed that the ethanolic extract of Coriandrum sativum L. expressed the highest total polyphenol content (113.08 mgGAE/g DW) and flavonoids (72.64 mgQE/gDW). On the other hand, for antioxidant activity, the lowest IC$_{50}$ values were reached at 78,309 µg/mL and 54,489 µg/mL, corresponding to DPPH and ABTS free radical scavenging activities. These results show that Coriandrum sativum L. is a precious source of natural bioactive and suitable for apply in the food industry as well as in daily meals.

Acknowledgments
This work was supported by grants from Nguyen Tat Thanh University, Ho Chi Minh City, Viet Nam.

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