



Hydrogen Peroxide Scavenging by Methanolic Extracts of Coriander: An *In Vitro* Antioxidant Study

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Abstract

Most of the nutraceutical plants, plants associated products and foods are known for their promising antioxidant properties due to the presence of several metabolites like polyphenolic compounds, flavonoids, terpenoids, vitamin C and many other. These molecules have strong tendency to scavenge the free radicals (reactive oxygen species) generated inside our body system due to the various reasons. Out of several methods for the antioxidant activity determination; hydrogen peroxide scavenging activity is an important method. This method has been used to determine the percentage scavenging activity of coriander seeds methanolic extract and coriander leaves methanolic extract for four different concentrations i.e. 100, 200, 300, and 400 µg/mL. Coriander seeds methanolic extracts showed the good level of percentage hydrogen peroxide scavenging activities in the range of 33.67-60.2% while scavenging activities for methanolic extract of coriander leaves were in the range of 47.95-70.61%. Range of scavenging activity for standard ascorbic acid was 65.12-81.35%. Although, extracts showed lower scavenging activity than standard ascorbic acid but result was promising indicating the good antioxidant activities of these extracts. Study demonstrates that methanolic extract of coriander leaves showed higher antioxidant activity (H₂O₂ scavenging activity) than coriander seeds and thus, coriander leaves are better antioxidant plant source.

Keywords: Hydrogen Peroxide; Percentage Hydrogen Peroxide Scavenging Activity; Antioxidant Activity; Coriander Seeds; Coriander Leaves; Methanolic Extract

Introduction

Edible plants, plant's originated materials and foods play significant role in the human life due to their nutritious benefits in enhancing the human health [1-4]. One of the most advantageous properties of plants or herbs based edible food products are the antioxidant properties and their tendency to scavenge reactive oxygen species like hydroxyl radical (OH[•]),

superoxide (O₂^{•-}), hydroperoxide etc. These are very reactive oxygen species and very harmful for the human health and cause the oxidation of lipid and protein [5]. Usually, these free radicals can be scavenged by the antioxidant system of our body and thus, balance between oxidation and anti-oxidation processes is maintained [5]. But, due to the various environmental or other adverse human activities, generation of free radicals in our body may be increased. In these

situations, exogenous antioxidants' uses may ameliorate the damages (caused by oxidative stress) by checking the chains of oxidative reactions, performing as scavenger of free radicals, singlet oxygen and reducing agents' quenchers [6].

Phytochemicals of plant origin have a significant place among the compounds with promising antioxidant activities [7]. Phenolic components are the responsible factor for these antioxidant activities while it is less linked with vitamins [8-10] but vitamin C, E, or A are known for their strong antioxidant properties [7,11]. Broad antioxidant defense system is possessed in the plants in the form of enzymes and metabolites which have tendency to prevent the oxidative damage done by the reactive oxygen species or free radicals [12]. Major metabolites (water soluble antioxidants) with strong antioxidant properties are ascorbate (Vitamin C) and glutathione but polyphenols, flavonoids and terpenoids like secondary metabolites are also strongly involved in the destruction of reactive oxygen species under various stresses [13-17].

Thus, out of several reactive oxygen species scavengers; coriander (*Coriandrum sativum* L.) seeds and leaves are also renowned for their strong antioxidant potential. The principle aim of this work was to obtain the coriander (*Coriandrum sativum* L.) seeds and leaves from Muzaffarpur (Bihar, India), dry them properly, convert into powdered form, extract with methanol using Soxhlet apparatus and use the concentrated extracts (oleoresin i.e. mixture of resin and essential oil) for hydrogen peroxide scavenging activities determination to know the potential of these extracts in the scavenging of hydrogen peroxide and its generated hydroxyl free radicals.

Experimental

Materials

pH 7.4 phosphate buffer (50 mM concentration), H₂O₂, deionized water, pH meter (digital), electronic balance (K-Roy), NaH₂PO₄·H₂O and Na₂HPO₄ for buffer preparation, ascorbic acid as standard, coriander seeds (dried) obtained from Muzaffarpur (Bihar) and coriander green leaves also obtained from Muzaffarpur (Bihar) and dried for extraction, methanol, Soxhlet apparatus, heating mantle (temperature controlled) double beam UV-Visible spectrophotometer (Systronics).

Methods

Extraction

Methanolic extraction of coriander seeds and leaves was done by using the Soxhlet apparatus. Extraction was done for three rounds in each case. After extraction,

extracts were concentrated keeping it in beaker at 30-35°C using heating mantle up to approximately 5 mL. Stock solution of concentration 10 mg/mL was prepared from this concentrated methanolic extract was prepared for both extracts separately.

In vitro Percentage H₂O₂ Scavenging Activity Determination

Hydrogen peroxide scavenging activity determination is based on the literature study [18-22]. The 40 mM H₂O₂ was prepared in phosphate buffer (50 mM) with 7.4 pH. Plant extracts (100, 200, 300 and 400 µg/mL concentrations) were taken in the solution of phosphate buffer of 7.4 pH having H₂O₂. After 10 minute of the addition of plant sample extract, absorbance was taken at 230 nm in UV-Visible double beam spectrophotometer for each concentration (i.e. 100-400 µg/mL) and for each extracts in separate studies. Same study was also performed for standard solution of ascorbic acid with same concentrations i.e. 100-400 µg/mL. Percentage H₂O₂ scavenging activity was calculated using following formula [18-22] for each concentration i.e. 100-400 µg/mL.

$$\text{Percentage H}_2\text{O}_2 \text{ scavenging activity} = \frac{[(A_{\text{Control}} - A_{\text{Sample}})/A_{\text{Control}}] \times 100}{}$$

A is the absorbance.

Results and Discussion

Hydrogen peroxide scavenging activity of coriander seeds and leaves extract also shows the antioxidant potential of these extracts. Ascorbic acid was used as a standard for the comparison of antioxidant potential of these plant extracts. Methanolic extract solution of each type was subjected to *in vitro* percentage H₂O₂ scavenging activity determination for four different concentrations of coriander seeds and leaves extracts (100, 200, 300 and 400 µg/mL) in order to get the percentage values for these concentrations. Each concentration shows the concentration of each of the extracts (coriander seeds and leaves extracts separately) in the 50 mM phosphate buffer with 40 mM H₂O₂ solution. Coriander seeds' methanolic extract for 100, 200, 300 and 400 µg/mL showed the good level of percentage H₂O₂ scavenging activity (H₂O₂ scavenging activity of coriander seed methanolic extract is presented as HSACSME) which was observed as 33.67, 47.99, 54.08, and 60.2%, respectively. On the other hand, percentage H₂O₂ scavenging activities of the coriander leaves methanolic extract (HSACLME) for the same range of concentrations as 100, 200, 300 and 400 µg/mL were also determined which were observed as 47.95, 50, 58.16, and 70.61%, respectively. These values were compared for the same concentrations of the standard solution of ascorbic acid. H₂O₂ scavenging activity of ascorbic acid (SAA) for the concentrations 100, 200, 300 and 400 µg/mL were observed as 65.12, 70.62,

78.28, and 81.35%, respectively.

Study suggests that coriander seeds and coriander leaves both show the good level of scavenging activities at 200, 300, and 400 $\mu\text{g}/\text{mL}$ concentrations but the maximum scavenging activities was observed at 400 $\mu\text{g}/\text{mL}$ for the coriander seeds as well as coriander leaves methanolic extracts. It was also

observed that coriander leaves methanolic extract (70.61%) showed better percentage scavenging activity than coriander seeds methanolic extract (60.2%). Figure 1 shows the concentrated methanolic extracts (oleoresin i.e. resin+essential oil) of coriander seeds and leaves (oleoresins). Figure 2 shows the hydrogen peroxide scavenging activities of seeds, leaves and standard ascorbic acid.



Figure 1: Concentrated methanolic extracts (Oleoresin) (a) coriander seeds and (b) coriander leaves.

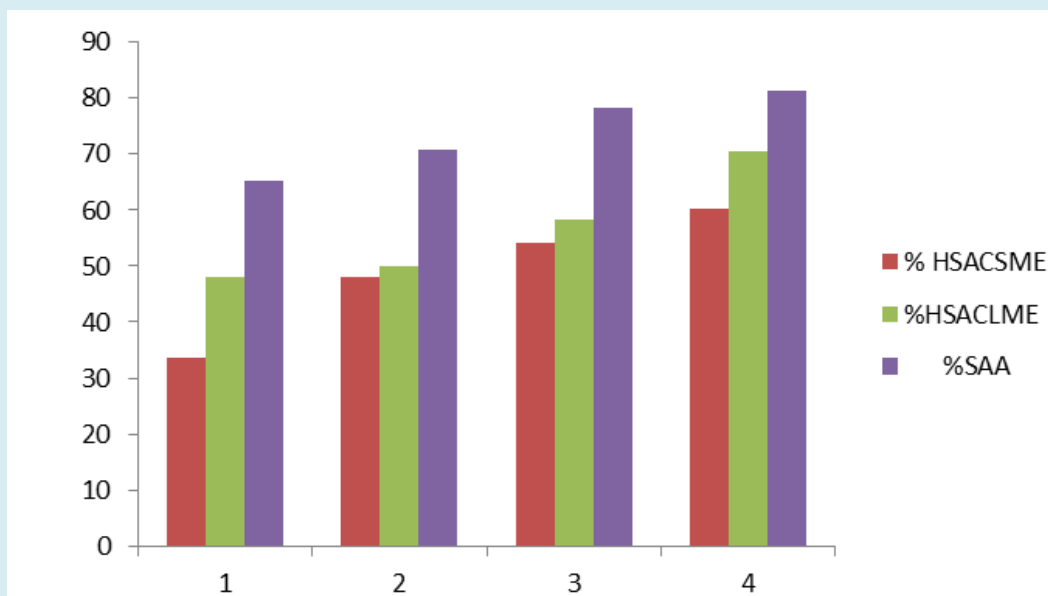


Figure 2: Percentage H_2O_2 scavenging activity of coriander seeds methanolic extract (HSACSME), coriander leaves methanolic extract (HSACLME) and ascorbic acid as standard (SAA).

There are number of methods for the determination of antioxidant activities of any plant materials like DPPH method (2,2-diphenyl-1-picrylhydrazyl), ABTS methods (2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid)) and many other [23,24]. Percentage H_2O_2 scavenging activity is also a effective type of method for the determination of antioxidant potential of any compounds or plants sources in term of hydrogen peroxide scavenging activity [18-22,24,25]. In our study, coriander leaves showed some greater hydrogen peroxide scavenging activity than coriander seeds.

Study of Wangenstein, et al. [26] also presents that coriander leaves have better antioxidant properties than coriander seeds. H_2O_2 does not show very high reactivity itself but it may be toxic for the cells due to the generation of hydroxyl radical inside the cells [27]. Due to the generation of hydroxyl radical by hydrogen peroxide, its elimination is very necessary for the antioxidant defense in food system or cells [19]. There are also several works on the different varieties of coriander's antioxidant activities using different methods [26,28-31].

Conclusion

Study suggests that coriander leaves have good level of antioxidant properties than coriander seeds in term of hydrogen peroxide scavenging activity. Methanolic extract of seeds showed the scavenging activities in the range of 33.67-60.2% while scavenging activities for methanolic extract of coriander leaves were in the range of 47.95-70.61%. Maximum percentage scavenging activities for the tested concentration range of 100-400 $\mu\text{g/mL}$ were obtained for 400 $\mu\text{g/mL}$ i.e. 60.2% for the methanolic extract of coriander seeds while 70.61% for the methanolic extract of coriander leaves. These percentage scavenging activities were lower than the standard molecule used for the study i.e. ascorbic acid for which maximum activity was 81.35%. Although, the tested plant extracts have lower percentage scavenging activities than standard molecule but they are in the promising range of a good antioxidant material.

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Conflict of Interest

Not applicable

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