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PHYTOCHEMICAL VARIATION OF PHENOLS, FLAVANOIDS AND ANTIOXIDANT POTENTIAL IN DIFFERENT PARTS OF CORIANDER (CORIANDRUM SATIVUM)

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ABSTRACT

This study evaluates the impact of post-harvest drying methods on the quality and antioxidant activity of coriander, a spice known for its medicinal properties and high quercetin content. Coriander's moisture content at harvest necessitates effective drying techniques to minimize microbial attack and maintain quality. The study compares the effects of shade drying, sun drying, and hot air oven drying on coriander's chemical constituents and antioxidant properties. Preliminary phytochemical screening of methanol extracts from various parts of coriander revealed the presence of polyphenols, flavonols, carbohydrates, proteins, and glycosides, regardless of the drying method. Total phenol and flavonoid contents were highest in shade-dried stems and lowest in hot air oven-dried roots. The DPPH free radical scavenging method showed that shade-dried parts exhibited the best antioxidant activity, followed by sun-dried and hot air oven-dried parts. The findings indicate that shade drying is superior in preserving phenolic and flavonoid contents and enhancing antioxidant activity. This suggests that optimizing post-harvest drying methods, particularly shade drying, is crucial for improving the export quality of coriander. Further studies using advanced analytical techniques like HPLC and GC are recommended to quantify individual chemical constituents and their distribution in different parts of the coriander plant.

Keywords: Coriander, Post-harvest drying, Antioxidant activity, Shade drying, Phytochemical screening, Polyphenols, Flavonoids, Quercetin, DPPH scavenging, HPLC, GC, Methanol extract.

INTRODUCTION

Plants have always played a crucial role in healthcare, providing a vast array of medicinal compounds. According to the World Health Organization (WHO), around 80% of the global population relies on traditional medicine, especially plant-based remedies, for primary health care. India, the birthplace of traditional practices like Ayurveda, Siddha, and Unani, boasts over 6,000 medicinal plants and a rich history of practical knowledge in traditional medicine. These practices, officially recognized alongside modern allopathic medicine, have flourished in India, offering a wide range of herbal drugs used regularly by millions as spices, home remedies, health foods, and over-the-counter medications. Historically, India has been known as the legendary land of spices. The Malabar Coast, in particular, maintained active trade relations with the Western world since ancient times. India's diverse agronomic and climatic conditions enable the cultivation of numerous spices, whose flavoring properties primarily derive from volatile and fixed oils, and oleoresins. These phytochemicals, secondary metabolites, evolved as protective mechanisms against herbivorous insects, vertebrates, fungi, pathogens, and parasites. Coriander (Coriandrum sativum), a notable example, is used both as a vegetable and spice. Its seeds, known for their aniseed or licorice-like flavor, have been valued for culinary and mystical properties. While gaining popularity in the U.S. as a vegetable or salad ingredient, coriander has long been a staple in European and Chinese cuisine. Its essential oil, rich in compounds like trans-anethole, coriandral, and various terpenic hydrocarbons, has been analyzed using gas chromatography and mass spectrometry, revealing significant components such as (E)-anethole, limonene, and apiole. Research has shown that the essential oils from different varieties of coriander exhibit diverse chemical compositions and biological activities. The Indian Institute of Spices Research (IISR) identified post-harvest handling as a major factor affecting the quality of spices, including coriander. Mishandling and unhygienic practices during processing and storage lead to significant quality deterioration and rejection in export

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markets. Additionally, the quercetin content in coriander, a potent antioxidant, varies with environmental conditions and post-harvest treatment. This study aims to improve the export quality of coriander by addressing post-harvest technology. Drying, a critical post-harvest process was selected for investigation to enhance the yield and activity of different parts of the coriander plant. The objective is to identify yield-limiting steps and assess the impact of drying on the chemistry and antioxidant potential of methanol extracts from various parts of the plant. This research seeks to devise methods to optimize post-harvest handling, thereby enhancing the quality and marketability of coriander.

METHODOLOGY

Collection, Identification and Authentication

Fresh coriander plants were collected from Tirumala Hills in Tirupati, India, along with fresh fruits sourced from a local herbal drug store in Tirupati. The taxonomical identification and authentication of the plants were carried out by Dr. P. Jayaraman, Director of the National Institute of Herbal Medicine, Plant Anatomy Research Centre, and Chennai.

Physical parameters

The Physical parameter such as loss on drying, ash values were identified as per standard guidelines.

Extraction

50g of powdered material of each part of the Coriander plant was extracted separately using methanol using soxhelt apparatus. The extract was concentrated and traces of the solvent were completely removed under reduced pressure and stored in vacuum desiccators for further use.

Preliminary Phytochemical analysis

The concentrated extracts were subjected to chemical tests for the identification of the various constituents as per the standard procedures in Kokate and Trease and Evans.

Determination of total phenolic content

The total phenolic content was determined using Folin–Ciocalteu reagents with analytical grade gallic acid as the standard. (Mariela González et al., 2003).

Total flavonoid content

Standard curve of Quercetin

1mg of quercetin was weighed and dissolved in 100ml of methanol and successive dilutions were made to make up the concentrations 2,4,6,8 and 10 µg/ml. 5mL of 2 % aluminium trichloride (AlCl 3) in methanol was mixed with the same volume of the quercetin solution (0.4 mg/mL).

Absorption readings at 415 nm using UV-VIS spectrophotometer were taken after 10 minutes against a blank sample consisting of a 5 mL quercetin solution with 5 mL methanol without AlCl 3.

Sample preparation

The total flavonoid content was determined using the Dowd method [16]. 5 mL of 2 % aluminium trichloride (AlCl 3) in methanol was mixed with the same volume of the extract solution (0.4 mg/mL). Absorption readings at 415 nm using UV-VIS spectrophotometer and readings were taken after 10 minutes against a blank sample consisting of a 5 mL extract solution with 5 mL methanol without AlCl 3. The total flavonoid content was determined using a standard curve of quercetin. Total flavonoid content is expressed as mg of quercetin equivalents (QE) / g of extract.

ANTIOXIDANT ACTIVITY

Invitro DPPH radical scavenging activity

In order to determine the radical scavenging ability, the method reported by Mensor et al. [35], was used. Briefly, 0.3 mM alcohol solution of DPPH (1 mL) was added to samples (2.5 mL) containing different concentrations of extracts like 200, 400, 600, 800 and 1000 mcg/ml. The samples were first kept in a dark place at room temperature and their absorbance was read at 518 nm after 30 min. The antiradical activity (AA) was determined using the following formula:

AA% = 100 x (Abs:sample - Abs:empty sample) x 100)/ Abs:control

Blank samples contained 1 mL ethanol and 2.5 mL from various concentrations of each extract; control sample contained 1 mL of 0.3 mM DPPH and 2.5 mL ethanol. The optical density of the samples, the control and the empty samples were measured in comparison with ethanol. One antioxidant, BHT (Butyl Hydroxyl Toluene) used as positive control (STD).

Comparing the drying efficiency in stems, Hot air oven dried stems yielded in least content of phenols and flavonoids. This suggests that Shade drying is better than Sun drying better than Hot air oven drying. In contrast, Hot air oven dried fruits showed a better yield compared to sun dried fruits. This may be due to degradation of chemical constituents due to UV radiation from direct sunlight. In most cases, Sun drying and Hot air oven drying gave almost similar results which can be concluded that temperature had its role in maintaining the yield of chemical constitutents in respective parts. Interestingly, fruits showed contrast results proving sun drying results in further decrease in the chemical constituents due to electromagnetic radiation which is reported to destroy the chemical constituents in a plant. Overall it suggests that stems contain more flavonoids comparable to fruits better than roots better than leaves.

Drying had a significant effect on the antioxidant activity of the Coriander plant. From the table it is clear that stems showed the best antioxidant activity of 95.13% at 1000mcg/ml comparable to the standard, BHT of 94.54%. It is even better compared to leaves, fruits and roots. Correlating the phenol and flavonoid content in the extracts it can be stated that these are mainly responsible for the activity. A change in their concentration resulted in the variation in antioxidant activity. Very less activity was showed by Hot air oven dried roots of 30.86%. It can also

be stated that all the extracts showed a dose dependent activity against DPPH radicals.

From the results it was understood that drying also plays important role in determining the activity irrespective of the part. All the shade dried parts showed better activity compared to sun dried ad hot air oven dried parts. This can be again correlated with the variation in phenols and flavonoids on drying in the respective parts.

Table 1: Physical parameters of various parts of Coriander

Sl. No	Drug sample	Drying type	Loss on drying (% w/w)	Ash values (% w/w)		
				Total ash	Acid insoluble ash	Water soluble ash
1.	leaves	Sun dried	2.07	4.18	1.56	2.41
		Shade dried	7.44	4.20	1.49	2.36
		Hot air oven dried	5.20	4.16	1.52	2.38
2.	Stems	Sun dried	3.32	4.83	1.63	2.73
		Shade dried	9.85	4.84	1.59	2.51
		Hot air oven dried	6.43	4.79	1.58	2.67
3.	Roots	Sun dried	5.29	6.04	2.44	3.10
		Shade dried	12.41	6.01	2.48	3.04
		Hot air oven dried	6.06	6.07	2.51	3.13
4.	Fruits	Sun dried	3.63	4.26	1.70	2.54
		Shade dried	8.75	4.25	1.74	2.61
		Hot air oven dried	6.17	4.30	1.68	2.57

Table 2: Total phenol content and total flavonoid content.

Sl. No.	Sample	Drying	Total phenol content (mg gallic acid eq's / g extract)	Total flavonoid content (mg quercetin eq's / g extract)
1.	Leaves	Sun (SDL)	54.99	8.44
		Shade (SHL)	53.78	14.38
		Hot air oven (HDL)	21.11	5.45
2.	Roots	Sun (SDR)	19.06	8.87
		Shade (SHR)	35.65	12.57
		Hot air oven (HDR)	16.32	8.24
3.	Stems	Sun (SDS)	31.77	10.16
		Shade (SHS)	59.47	17.13
		Hot air oven (HDS)	29.36	9.63
4.	Fruits	Sun (SDF)	28.29	10.61
		Shade (SHF)	45.27	15.02
		Hot air oven (HDF)	41.04	9.50

Table 3: Effect of drying on antioxidant activity of various parts of Coriander.

Sl. No.	Sample	Drying	DPPH radical scavenging activity (AA%)				
			200 mcg/ml	400 mcg/ml	600 mcg/ml	800 mcg/ml	1000 mcg/ml
1.	Leaves	Sun (SDL)	70.32	77.83	83.12	85.66	86.34
		Shade (SHL)	74.26	79.63	85.41	89.28	91.29
		Hot air oven (HDL)	35.23	38.91	41.83	45.34	49.13
2.	Roots	Sun (SDR)	32.34	35.77	39.33	41.63	45.25
		Shade (SHR)	64.27	68.68	71.47	74.28	78.78
		Hot air oven (HDR)	24.98	27.48	29.07	30.30	30.86
3.	Stems	Sun (SDS)	42.29	45.17	48.06	49.62	51.20
		Shade (SHS)	79.51	85.08	90.94	93.55	95.13
		Hot air oven (HDS)	39.74	42.56	44.49	46.34	47.59
4.	Fruits	Sun (SDF)	38.76	42.00	45.21	48.03	49.34
		Shade (SHF)	77.18	81.50	87.50	88.64	89.75
		Hot air oven (HDF)	64.98	67.37	69.88	71.15	74.59
5.	BHT		82.07	81.00	85.84	91.57	94.54

Figure 1: Standard curve of gallic acid.

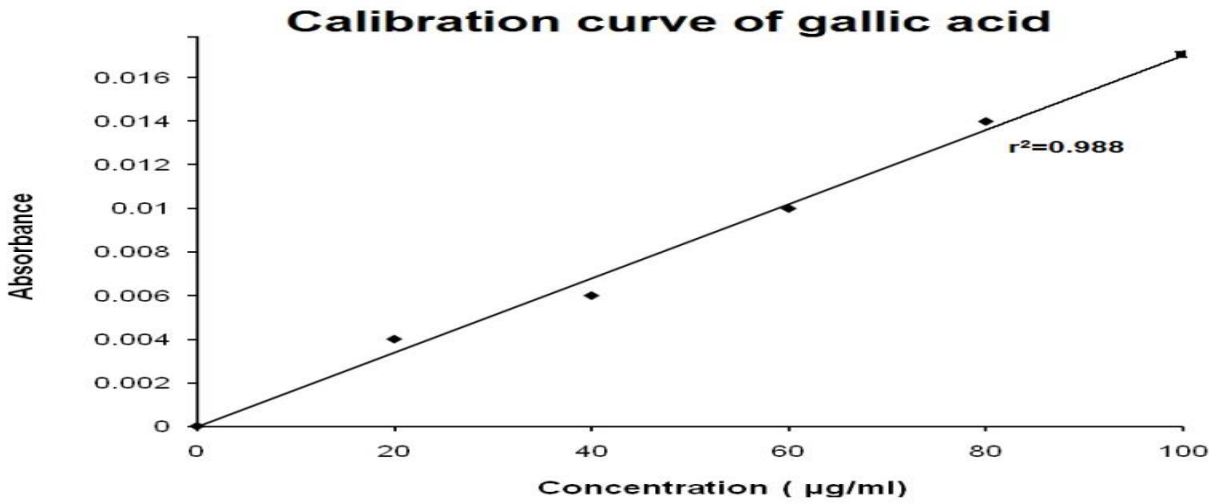
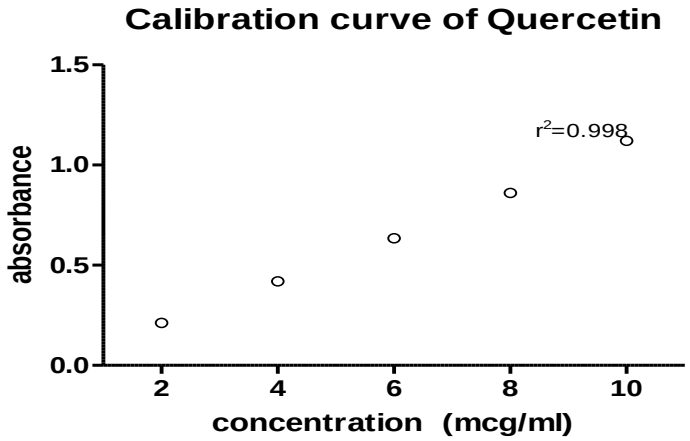


Figure 2: Standard curve of quercetin



DISCUSSION

Considering each and every step under post-harvest technology of spices, drying remains the most important operation. At the time of harvesting, spices like all other agricultural commodities invariably contain high moisture that must be brought down into the desired level at which attack of micro-organisms would be minimum. At the same time retention of quality attributes should also be at the maximum. The period between initial moisture level and final moisture level, however, is more crucial while adopting post harvest technologies. The removal of moisture is attained either naturally or artificially by heat or pressure. Thermal mode of drying is more prevalent and most studied. Adiabatic drying is the drying of a product simply by circulating relatively dry air around it.

However the percentage moisture content of spices varies considerably at the time of harvest. The direct exposure to the sun destroys colour, vitamins and flavour, and there is chance of contamination with dust, dirt, insect infestation, and contact with other pests. They may also be drenched by rain or dew and, may need further drying if mold growth is to be avoided during storage. If the drying process is not rapid enough, respiration continues in the tissue cells, and this leads to the utilization of sugar and the production of acids which account for the sour taste present in most traditionally dried products.

Coriander is one of the important spices known for its significant use as flavoring agent, carminative. It is proven to treat cancer, diarrhea and pocess antimicrobial, antifungal, hepato protective activities.

Moreover coriander plant is well known for its rich source of quercetin but the content varies in the plant in response to the minor changes in environment. The post harvest treatment of the plant also determines the quercetin content. The environment is such a factor that it cannot be controlled or maintained in a cost effective manner.. Therefore the objective of this study was to devise methods of post harvest technology to improve the export quality of coriander. Thus drying has been selected as a primary post harvest parameter and procedures were to be developed to validate the yield and activity of different parts of coriander.

Studies on loss on drying and ash values were performed and the results were under limits.

Methanol extract of various parts of coriander have been investigated for the presence of phyto constituents by performing preliminary phyto chemical screening. Results show the presence of polyphenols, flavonols, carbohydrates, proteins and glycosides in all the parts irrespective of the drying.

The total phenol content and total flavonoid content of extracts of various parts of coriander were determined using the standard graphs of gallic acid and quercetin. Out of all, extract of Shade dried stems was found to contain high phenol and flavonoid content and their least concentrations were found in extracts of Hot air oven dried roots. This suggests that Shade drying is better than Sun drying better than Hot air oven drying.

The maximum percentage inhibition of DPPH radicals by different extracts of various parts of coriander on drying was determined in DPPH free radial scavenging method. From the results it was understood that drying also plays important role in determining the activity irrespective of the part. All the shade dried parts showed better activity compared to sun dried ad hot air oven dried parts. Drying had a significant effect on the antioxidant activity of the coriander plant.

CONCLUSION

The study demonstrates that post-harvest drying methods significantly influence the antioxidant activity of coriander. Shade drying was found to preserve the antioxidant properties better than sun drying and hot air oven drying. This suggests that shade drying may be the optimal method for maintaining the beneficial properties of coriander. Future research should focus on quantifying the effects of different drying methods on individual chemical constituents using precise analytical techniques such as HPLC and GC. Additionally, investigating the distribution of these constituents in various parts of the coriander plant will provide further insights into optimizing post-harvest treatment for better yield and activity.

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