RESEARCH ARTICLE

Effects of Temperature and Storage Duration on Antioxidant Status in *Coriandrum Sativum* Linn.

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ABSTRACT- *Coriandrum sativum* Linn. is a promising functional food which is not only known to provide nutrition, but also medicinal benefits and is a potent source of antioxidants. The study monitors effect of storage temperature (-2.2^{o}C) and duration (0, 3, 6, 9 days) on antioxidant status of the plant. All parameters present in this study-Ascorbic acid, Tocopherol, Total phenols, SOD, POX, CAT, content was studied by spectrophotometric assays. A number of preservation methods have been designed to extend the shelf life of the food product and to maintain their antioxidant potential. The aim of the present study was to monitor changes in the above mentioned antioxidants during refrigerated storage. The study hypothesizes that as the storage period increases the level of enzymatic antioxidants increase with increase in degree of damage, whereas the non-enzymatic antioxidants decrease (except phenolic) and concludes that the overall antioxidant status of the plant decreases considerably during storage condition. During storage, these antioxidants probably react with free radical, produced by aerial oxygen and are depleted, decreasing their concentration, despite being stored at refrigerator conditions.

Key-words- Antioxidant activity, *Coriandrum sativum* Linn., Phenolic content, storage, temperature

INTRODUCTION

Coriander is an annual herbaceous plant belonging to family Umbellifereae (Apiaceae). South Asiais the world's largest producers, it is a cosmopolitan plant. The green, young coriander leaves (cilantro) and the aromatic coriander fruit or seeds are known to find its uses in culinary as garnishes and spice respectively. Various parts of this plant viz. seeds, leaves, flowers, fruits are known to possess antioxidant, anticonvulsant, antidiabetic, anti-mutagenic, antimicrobial, anthelminthic, antifungal, antibacterial, sedative hypnotic, diuretic, stomachic, spasmodic, and carminative activities [1-5]. Coriander contains essential oils, limpene, coriandrin, geraniol, citronellol, α-pinene, flavonoids, catechin, gallic acid, vicenin, Linalool etc, which give it the above assigned properties [2,5,6].

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Research literature also suggests that coriander has been explored *in-vivo* for its various biological activities such as prevention of oxidative damage, inhibition of microbial growth, diabetes management, neurological disease benefits, pain reduction etc [1].

Antioxidant activity of coriander

Coriander gets its antioxidant activity at the onus of bioactive compounds viz. flavones, isoflavones, flavonoids, anthocyanin, coumarins, lignins, catechin and isocatechins and is thus referred as store house for bioactive compounds [5,6]. Further research also suggests that the chemical compounds that coriander possess apart from above mentioned which attribute to antioxidant properties are apigenin, ascorbic acid, β-carotene, caffeic acid, camphene, γ-Terpinene, isoquercitin, myristic acid, myristicin, ρ-hydroxy-benzoic acid, palmatic acid, protocatechenic acid, Terpinolene, trans-anethole [5]. Coriander leaves show stronger anti-oxidant activity than seeds. There is a positive correlation between TPC and antioxidant effect, thus, screening of phenolic content in coriander will indicated the presence of compound with antioxidant activity [2,5]. In etheric extracts from coriander carotenoid fractions, β-carotenes were identified as principal antioxidant compounds [2]. Studies also indicate that antioxidant activity of

seed essential oils higher than coriander leaves essential oil. Many explorations have been done on activities using various extracts and various plant parts thus, making it a functional food.

Postharvest losses in relation to quantity and quality of food are major problems all over the world. Apart from appearance, texture, and flavors and nutritive value of bioactive compounds, quality parameters including storage duration and temperature also play a vital role to increase shelf-life of product and consumer acceptability [3,5]. Postharvest storage conditions, senescence etc. are known to have influence on antioxidant status and phenolic content of the plant [3,4,7,8]. The prospective (aim) of the current study was to monitorchanges in antioxidant levels in effect to storage duration and temperature (-2.2^{o}C). Current study focuses on analyzing three enzymatic antioxidants, three non-enzymatic antioxidants and a biochemical at a constant temperature, which would allow us to interpret optimal storage duration at that temperature for antioxidant retention and thus, enhancing consumer acceptability.

MATERIALS AND METHODS

The research was carried out at St. Xavier's college, Autonomous, Mumbai in Department of Botany. The study was carried out between December, 2016 and February, 2017.

Procurement of samples

Samples of *C. sativum* Linn. were purchased from a local market at Parnaka Vasai (W). The samples were identified using Flora's from Blatter Herbarium, St. Xavier's College, Mumbai.

Storage experiment

Samples were thoroughly washed under tap water, dried and then cleaned for impurities. Further, these were divided into four sufficiently equal amounts for preparing various types of extracts for assays to be conducted. The 0 day sample was extracted without giving any experimental conditions, whereas the other samples were wrapped in newspapers (a traditional house-hold practice) well labelled as per the days and kept in refrigerator. The temperature was monitored each day for 9 days using "Indoor Outdoor Thermometer with hygrometer clock" (mini-max thermometer).

Preparation of extracts

All the extracts of assigned assays had different solvent systems foe extraction. The samples were extracted in triplicates – sample A (mature leaves), sample B (young leaves), sample C (stolon). All extractions were carried out in cold condition (esp. for enzymatic assays). One gram of sample per 10 ml of respective solvent (concentration of sample = 100 mg/ml) used.

Determination of antioxidant status

For both enzymatic and non-enzymatic antioxidant analysis, the samples were prepared as they were procured after the applied conditions from *C. sativum L.* using standard methods, with few modifications as per laboratory convenience.

Enzymatic antioxidants

SOD was assayed according to the method of Kakkar [9]. Catalase activity was assayed following the method of Luck [10]. Peroxide activity was assayed by the method from Sadasivam and Manikam [11].

Non - enzymatic antioxidants

Ascorbic acid was quantified by the spectrophotometric assay method [12]. Tocopherol was estimated in the plant samples by the Emmerie-Engel reaction [13]. The amount of total phenols in the plant tissues was estimated by the method proposed by Mallick and Singh [14].

Biochemical assay

Protein estimation was assayed by the Lowry's method [11].

RESULTS AND DISCUSSION

The values presented in Table 1 and Table 2 states that *C. sativum* Linn. shows considerable amount of antioxidants,which are monitored over the period of 9 days. During this period the temperature was monitored and averaged out to be -2.2^{o}C. The values depicted in the tables are the means of triplicates of all samples.

Fig. 1: Showing abnormality of physical damage found on Day 3

The value presented in Table 1 shows the sample *C. sativum* Linn. possess considerable amount of activities of all enzymes analyzed. It is evident from the values that enzyme catalase was the only enzyme which was found in stolon region of each day samples, whereas other two enzymes were found in all triplicates of each day. The results presented in Table 2 revealed that the samples also contain

considerable amount of all the non-enzymatic antioxidants analyzed. All the samples were analyzed fresh under respective treated conditions. Day 3 showed abnormal moisture and ice-crystal formation during the storage conditions (Fig. 1), which was assumed to cause defective results in the overall study plan. Table 1 shows the activity of SOD over the study duration. There is an abnormal increment on the third day, which was found physically damaged in 9 day, whereas 6 day showed a moderate increase. Thus, making it uncertain to evaluate the trend. It further showed the activity of CAT. Here, there is a surprising drop in the Day 3 and the remaining study days show a steep decline in activity, thus bringing to a conclusion that there is a significant decrease in catalase activity as the storage period increases. Table 1 also exhibits the activity of POX. The enzyme activity showed sharp increase as per the degree of sample deteriorate (Day3) from Day 0 and Day 9. Along with enzymatic antioxidants the sample was assayed for vitamin C, vitamin E and total phenolic content. Table 2 shows the activity of ascorbic acid estimation Day 3 shows as abruptly large increase of ascorbic acid, whereas the amount reduces as further increase in duration. The vitamin C amount is for high from the literature value (135 mg/100g of sample) which further makes it an uncertain observation. It also shows the amount of vitamin E is found to be moderately less than the literature value. The amount of vitamin E showed a peak at Day 6 and decreases further over the study duration for total phenolic content estimation, it shows a peak, whereas Day 3 showed a reduced phenolic content, which makes it uncertain to draw conclusion as it contradicts with the hypothesis that phenolic content should increase with increase in duration of storage. Table 3 shows estimation of protein. Overall, through present study it can be concluded as a *C. sativum* Linn.is a potent source of antioxidants as well as storage duration and degree of deteriorate has a role in change antioxidant levels in the plant.

Table 1: Enzymatic antioxidant activities in *Coriandrum sativum* Linn.

Enzymes	Day 0	Day 3	Day 6	Day 9
Superoxide dismutase (U#/g leaf)	15.60	58.15	30.35	63.11
Catalase (U$/g leaf)	63.16	11.32	9.30	7.95
Peroxidase (U*/g leaf)	0.91	1.19	1.03	1.40

Notes:
 # 1 Unit = Amount of enzyme that causes 50% reduction in NBT oxidation
$ 1 Unit = Amount of enzyme required to decrease the absorbance at 240nm by 0.05 Units/minute
***1 Unit = Changes in absorbance at 436 nm/minute**

Table 2: Non-enzymatic antioxidant levels in *Coriandrum sativum* Linn**.**

PARAMETER	Day 0	Day 3	Day 6	Day 9
Ascorbic acid (mg/g leaf)	2.2	2.41	2.27	2.29
Tocopherol (µg/g leaf)	17.3	18.6	17.2	16.2
Total phenols (mg/g leaf)	1.13	0.42	1.78	1.26

CONCLUSIONS

As monitored, the overall antioxidant status of the plant decreases considerably during storage condition. During storage, these antioxidants react with free radical, produced by aerial oxygen and depleted, decreasing their concentration, despite being stored at refrigerator conditions. The study limits itself in uncertain about the effects that this duration will cause on human health. Most common change that occurs in green vegetables during storage conditions (processing) is conversion of chlorophyll to pheophytin, causing a color change from bright green to olive brown which is undesirable to consumers. This observation was made in our research on Day 3. Thus, emphasizing the need to find optimal storage conditions. The research opens new avenues to be explored if study plans were made to monitor effect on antioxidant status of any plant species by varying storage temperature and duration so that analysis can be made to estimate optimal storage temperature and duration for idle consumer acceptability and palatability at a house-hold as well as commercial or industrial level.

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