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Estimation of enzymatic and non-enzymatic antioxidants of *Solanum nigrum L.*

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Abstract

Biotic and abiotic stress creates oxidative stress and to be protected from oxidative stress, antioxidants play an essential role in medicinally crucial plants. Naturally, the plants contain enzymatic and non-enzymatic parameters. Solanum nigrum L. from Solanaceae is commonly known as European black nightshade or only black nightshade. It is one of the weeds which has got nutritive value. Soups are prepared from shoots in different parts of the world. The stalks and berries have medicinal and local uses. It has a high nutritive value. It has that it manages several diseases like seizure and epilepsy, pain, ulcer, inflammation, diarrhea, some eye infections, and jaundice. The dietary importance of Solanum is due to the source of foods and nutraceuticals for the prevention and management of cognitive impairment associated with diseases such as Alzheimer's disease. The present study was carried out for assessing the antioxidant status of leaves of this plant at the vegetative and fruiting stages. The work estimated enzymatic (peroxidase and polyphenoloxidase) and non-enzymatic antioxidants (proteins, reducing sugar, ascorbic acid, and polyphenols). It has been observed that the leaves possess an outstanding amount of enzymatic antioxidants. Among the non-enzymatic parameters are in considerable amount while the content of protein is more in ripe fruits. The medicinal properties of this plant refer to its use in the antioxidant formulations.

Keywords: Assay, antioxidants, enzymatic, non-enzymatic, *Solanum nigrum*

Introduction

The vast heritage of Vedic literature in India, which dates back to 2000 to 1000 B.C., contains valuable information regarding medicinal plants. These herbal medicines by way of decoctions, oils, powders, ointments will be a sure panacea for many ill. The natural medicinal properties of plants prevent the side effects which are caused after the use of allopathic remedies[1]. Extracts of several plants have shown to have antioxidant activities. *Solanum nigrum* Linn. is the plant chosen for the present study which has a long association with important medicinal properties since time immemorial. *Solanum nigrum* L. belongs to the family Solanaceae[2]. Its common name is European black nightshade or simply black nightshade or blackberry nightshade. Black nightshade is an agricultural weed[3]. In cotton crops, herbicides play an essential role in controlling many diseases[4]. *S. nigrum* is a very commonly found herb or may be considered as a short-lived perennial shrub. Both the surfaces are hairy; flowers are greenish to whitish. The fruit is a berry type. In young condition, they are green turn red or black when ripe[5]. Fruits grow in bunches.

Since early times, *Solanum nigrum* is used as the fruit was recorded as a famine food in 15th-century China[6]. Ethno botanical literature reported that the leaves and shoots of *S. nigrum* boiled as a vegetable. The boiled cooked water discarded several times to remove toxins[7]. Boiled leaves are firm and slightly bitter. The ripe blackberries are sweet and salty, blended with liquorice and melon[8]. In Kenya, leaves of *S. nigrum* blanched and sautéed, salted, and consumed with corn. In Tanzania, *S. nigrum* is a popular green vegetable, sautéed with chicken or pork and eaten with corn. It is a delicious and costly meal in most of the restaurants in urban areas. The commercialization of berries and leaves of *S. nigrum* has still not taken place. South Indian people cook leaves and berries with tamarind and cumin seeds[9]. The fruits are commonly consumed in Tamil Nadu, Kerala, southern Andhra Pradesh, and south of Karnataka. The young leaves and fruits are locally used in Indonesia and are known as *ranti* (Javanese) or *leunca* (Sundanese). As part of a traditional salad or dried fruits are used in many Asian countries[10].

The young shoots and berries are highly nutritious[11]. Due to its nutritive value, many developing countries used as vegetables and fruits. It is used for various folklore medicinal and local uses[12,13]. It has been documented that it manages several diseases like seizure and epilepsy, pain, ulcer, inflammation, diarrhoea, some eye infections and jaundice[14,15]. The dietary importance of *Solanum* is due to the source of foods and nutraceuticals content of scopolamine for the prevention and management of cognitive impairment associated with diseases such as Alzheimer's disease[16]. *S. nigrum* plays a vital role in the traditional medicine practices of India. Its solutions or derived medicines are used in dysentery, stomach complaints, and fever.

Ulcers and other fatal skin diseases are quickly cured by the juice of its parts. The fruits have been previously used as a laxative, tonic, appetite stimulant, and for treating asthma and excessive thrust[17]. The extracts of leaves and berries have been used to eliminate liver-related ailments in the North Indian region. In Assam, the extract from its roots is used to fight asthma and whooping cough diseases[18]. In traditional Asian medicines, *S. nigrum* is considered to be, antioxidant, anti-inflammatory, hepatoprotective, antitumorigenic, diuretic, and antipyretic[14, 19]. The solanine content of *S. nigrum* prevents the multiplication of breast cancer and pancreatic cancer cells in vitro. It inhibits tumor metastasis[20,21]. In the current study, the enzymatic (peroxidase and polyphenoloxidase) and non-enzymatic antioxidants (proteins, reducing sugar, ascorbic acid, and polyphenols were estimated to understand their properties and concentration present in the plant.

Materials and methods

Naturally grown plants were collected from the botanical garden, Fergusson College Campus, Pune. The leaves were collected fresh for the assay of each parameter. Enzymic parameters are peroxidase, polyphenol oxidase, Non-enzymatic parameters used here are ascorbic acid, polyphenols, reducing sugars, total carbohydrates, starch & proteins.

The parameters were analyzed at the vegetative & fruiting stage. The enzymic, non-enzymic & organic constituents were examined using protocols such as for enzymic antioxidants; peroxidase[22] and polyphenol oxidase[22]. Similarly for non-enzymic antioxidants such ascorbic acid[23], polyphenols[24], reducing sugar[25], starch[26] and proteins[27].

Results and discussion

Free radical-induced cellular damage is implicated in malignancy, aging, neurodegenerative diseases, diabetes mellitus, cardiovascular diseases, liver damage, and many more. Several studies have been carried out on antioxidants and the mechanisms by which they render protection from oxidative damage. Many indigenous plants are being used in the preparation of numerous traditional formulations[28]. The therapeutic effectiveness of such formulations could be due to the antioxidants principles of the constituent herbs. The assay of antioxidant enzymes revealed that the *Solanum nigrum* leaves at the vegetative stage are a rich source of the antioxidant enzymes.

Peroxidase and polyphenol oxidase are among the most studied enzymes in fruits and vegetables[29], and many reports suggest their role in antioxidation. The leaves of *Solanum nigrum* were also a good source of non-enzymic and enzymic antioxidants.

Ascorbic acid has been established to be an effective scavenger of free radicals and has reported reducing carcinogenic nitrosamines to inactive products[30,31].

Polyphenolic compounds have been evolved as a means to render protection and defense to plants against pathogens and have been now shown to have antioxidant roles. Natural plant polyphenols have also been reported to be promising in the treatment of lymphocyte malignancy[32]. The critical compounds have also been shown to exhibit a cellular defense mechanism in atherogenesis and cancer[33]. The leaves of *Solanum nigrum* were enriched in many polyphenolic compounds, including phenolic acids and flavones[34]. The presence of many polyphenolic compounds in the stem and leaves of *Solanum nigrum* attribute to antioxidant activity[35]. The role of carbohydrates and protein is well documented in the human diet.

Table-1: Enzymic and non-enzymic oxidants organic constituents in *Solanum nigrum* Linn.

Parameters stage	Vegetative stage (mature leaves)	Vegetative stage (tender leaves)
Peroxidase (Units/g)	161	1295
Polyphenol Oxidase (Units/g)	4988	5102
Protein (mg/g)	0.57 (6mg)	.033 (3mg)
Polyphenol (mg/g)	.016	.012
Reducing sugar (mg/g)	.012	.011

Parameters stage	Fruiting stage (Ripe fruits)	Fruiting stage (Unripe fruits)
Peroxidase (Units/g	170	1305
Polyphenol Oxidase (Units/g)	4896	4991
Protein (mg/g)	4.5106	.047
Polyphenol (mg/g)	.06	.038
Reducing sugar (mg/g)	.010	.005

Peroxidase, 1 unit = change of absorbance min^{-1} at 430nm. Poly Phenol Oxidase, 1 unit = amount of enzyme which transforms one micromole of dihydric phenol to quinine.

It has been observed that the leaves possessed the right amount of enzymatic antioxidants. Among the non-enzymatic parameters are in considerable amount while the content of protein is more in ripe fruits. The medicinal properties of this plant refer to its use in the antioxidant formulations.

Conclusion

From the results of the present study (Table-1), it is apparent that leaves of *Solanum nigrum* possess considerable levels of both enzymic and non-enzymic antioxidants.

It brings to emphasis the importance of the plant in the ever growing antioxidant synthesizing industry. Being a weed, it is highly adapted to changing conditions which makes it the best material for extraction of antioxidants. Thus this works throws light on the potential use of *Solanum nigrum* leaves to battle the innumerable diseases and disorders linked with oxidative damages.

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