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ANTIOXIDANT ACTIVITY OF ETHANOLIC LEAVES EXTRACTS OF *BETA VULGARIS*

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Abstract

The many number of medicinal plants are used in the cellular and metabolic disease treatment such as diabetes, obesity, poly cystic ovarian disorder and cancer etc. There are some speculations that the generation of free radicals inside the body in some physiological conditions is resulted in the cellular changes and development of degenerative disease and this could be neutralized by the antioxidants from different medicinal plants. Several studies have shown that plant derived antioxidant neutraceuticals scavenge free radicals and modulate oxidative stress-related degenerative effects. The beet, *Beta vulgaris* is a plant in the Chenopodiaceae family. It is best known in its numerous cultivated varieties, the most well-known of which is the purple root vegetable known as beetroot or table garden beet. In the present study, the *In vitro* anti-oxidant activity was carried out by the inhibitory activity of against the DPPH , H_2O_2 Scavenging Assay and Reducing power Assay. The inhibition of these compounds may increase the anti-oxidant capability.

Key words: Antioxidant neutraceuticals, *Beta vulgaris*.

Introduction

Traditional medicine from plant extracts has proved to be clinically effective and relatively less toxic than the existing drugs [1]. Successful determination of biologically active compounds from plant material is largely dependent on the type of solvent used in the extraction procedure [2]. Phytochemicals (secondary metabolites) are bioactive chemicals of plant origin. They are naturally synthesized in all parts of the plant body: bark, leaves, stems, roots, flowers, fruits, seeds, and so on [3]. They have been recognized as the basis for traditional herbal medicine practiced in the past and now [4]. All plant parts are usually screened for phytochemicals that may be present; the presence of a phytochemical of interest may lead to its further isolation, purification, and characterization. Then it can be used as the basis for a new pharmaceutical product. Medicines derived from plant extract are being used to treat a wide variety of clinical disease [5]. Traditionally, natural products has established store house of numerous bioactive compounds, which provide an endless source of medicine. Crude herbs have long been the basis of many traditional medicines worldwide. The leaves of *Beta vulgaris* contain powerful antioxidants. The beet, Beta vulgaris is a plant in the Chenopodiaceae family. It is best known in its numerous cultivated varieties, the most well-known of which is the purple root vegetable known as beetroot or table garden beet. Beets have been used in traditional medicine for hundreds of years to treat constipation, gut and joint pain, dandruff [6]. Modern pharmacology shows that red beet extracts exhibit antihypertensive and hypoglycaemic activity as well as excellent antioxidant activity. The promising results of their phytochemicals in health protection suggest the opportunity for their use in functional foods(7).

Material and methods

In Vitro antioxidant activity(8,9 and 10)

Scavenging activity of 2, 2-Diphenyl-1-Picrylhydrazyl (DPPH) radical (10)

The ability to scavenging the stable free radical, DPPH was measured as a decrease in absorbance at 517 nm by the method. About 0.1 ml of DPPH-methanol solution (0.135 mM) was mixed with 1.0 ml of different concentrations of various extracts of *Beta vulgaris* leaf extract.The reaction mixture was vortexed thoroughly and left in the dark at room temperature for 30 min. The absorbance of the mixture was measured spectrophotometrically at 517 nm. Rutin and Butylated hydroxyl toluene (BHT) were used as standard drugs. The percentage of free radical scavenging was calculated according to the following equation:

%scavenging = 100–(Abs sample–Abs blank)/Abs Control × 100.

Scavenging of hydrogen peroxide

The ability of the ethanolic leaf extract of *Beta vulgaris* to scavenge H_2O_2 was determined.

A solution of H_2O_2 (40 mM) was prepared in phosphate buffer (pH 7.4). H_2O_2 concentration was determined spectrophotometrically from absorption at 230 nm in a spectrophotometer (SL 159, UV- Visible Spec, Elico, India). Extracts (200, 400, 600, 800 and 1000 μg) in distilled water were added to a H_2O_2 solution (0.6 mL, 40 mM). Absorbance of H_2O_2 at 230 nm was determined after ten minute against a blank solution containing phosphate buffer without H_2O_2. The percentage of scavenging of H_2O_2 of *Beta vulgaris* and standard was calculated using the following equation:

$$\% \text{ Scavenging} = \frac{\text{Control OD - Test OD}}{\text{Control OD}} \times 100$$

Reducing Power

The reducing power of ethanolic leaf extract of *Beta vulgaris* was determined by the method of Oyaizu (1986). Substances which have reduction potential react with potassium ferricynaide to form potassium ferrocynaide, which then reacts with ferric chloride to form ferric-ferrous complex that has an absorption maximum at 700 nm. An increase in the reduction of ferric to ferrous ion increases the absorbance indicating the reducing ability of ethanolic leaf extract of *Beta vulgaris*.

Procedure

Varying concentrations of ethanolic leaf extract of plant in double distilled water was mixed with 2.5 mL of phosphate buffer and 2.5 mL of potassium ferricyanide. The mixture was incubated at 50 °C for 20 min, after which, 1.5 mL of TCA was added and centrifuged at 3000xg for 10 min. From all the tubes, 0.5 mL of supernatant was mixed with 1 mL of distilled water and 0.5 mL of ferric chloride. The absorbance was measured at 700 nm in a spectrophotometer. The increased absorbance of the reaction mixture indicated increasing reducing power. Incubation with water in place of additives was used as the blank.

Result and Discussion

Reducing assay

Table1: Anti-Oxidant Activity of leaf extract of *Beta vulgaris* by using Reducing assay

TEST	CONCENTRATION OF PLANT EXTRACT(mg/ml)	% OF INHIBITION	Ascorbic acid
Reducing assay	20	45	50
	40	55	55
	60	65	65
	80	75	70
	100	80	80
IC_{50} Value		28.8	22.6

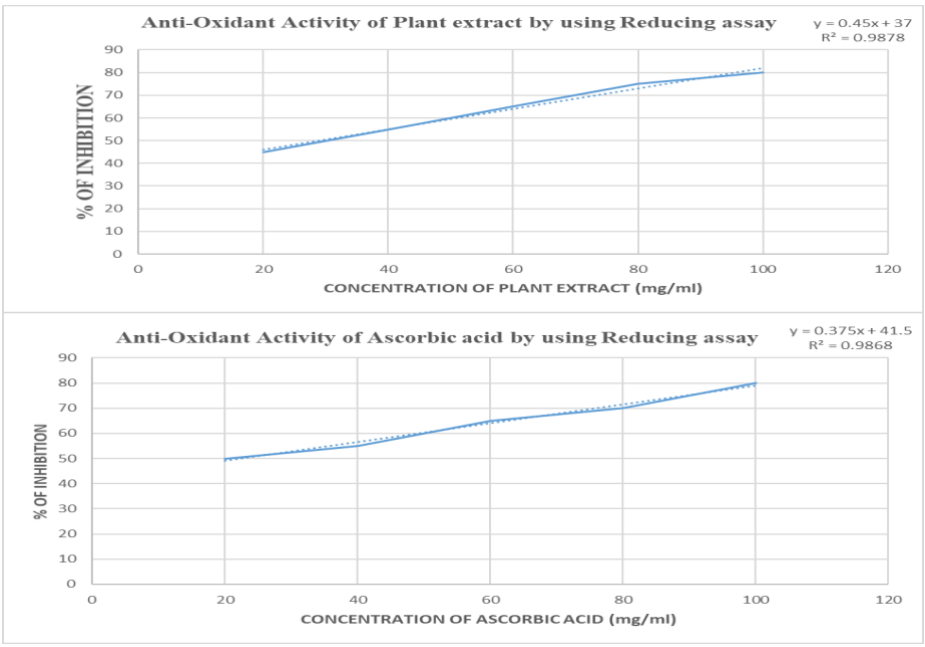
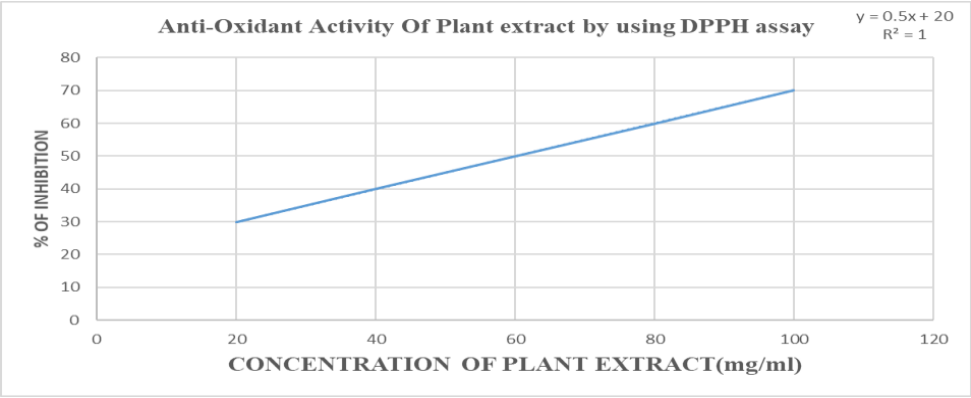


Fig 1:Anti-Oxidant Activity of leaf extract of *Beta vulgaris* by using Reducing assay

Table2: Anti-Oxidant Activity of leaf extract of *Beta vulgaris* by using DPPH assay

TEST	CONCENTRATION OF PLANT EXTRACT(mg/ml)	% OF INHIBITION	Ascorbic acid
DPPH assay	20	30	56
	40	40	65
	60	50	70
	80	60	76
	100	70	80
IC_{50} Value		60	8.5



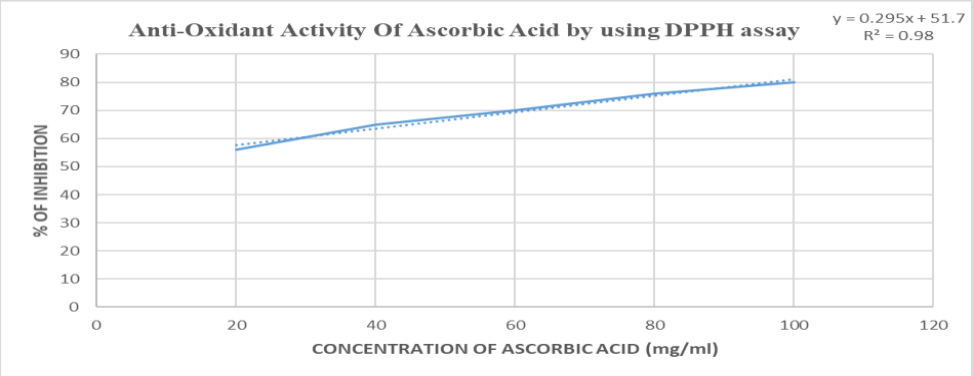
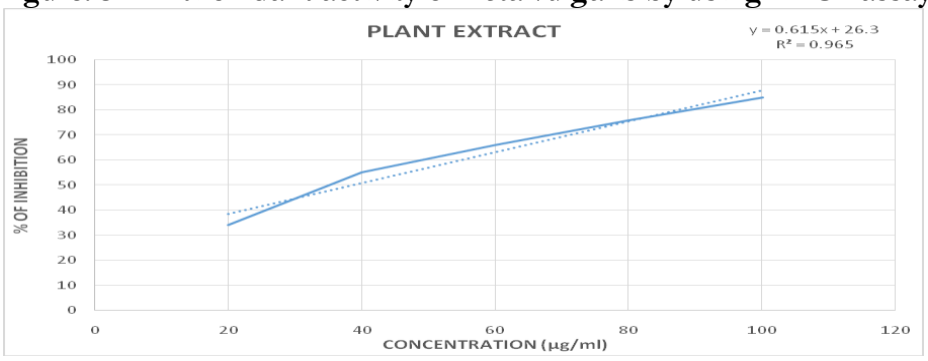


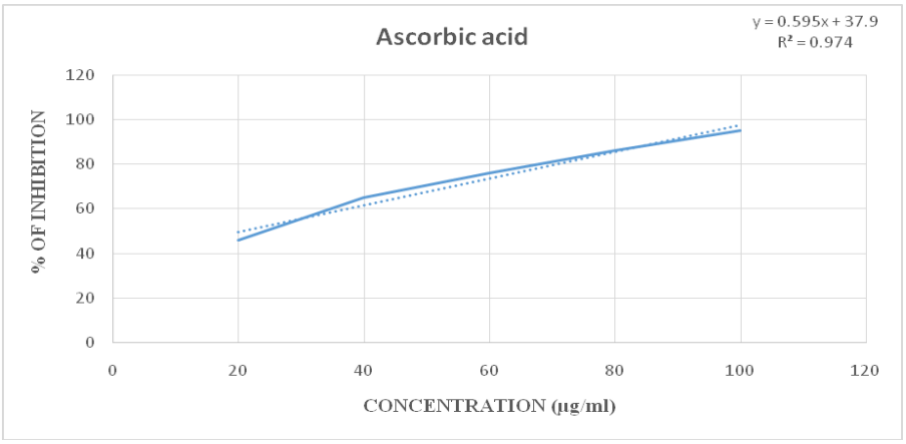
Fig 2:Anti-Oxidant Activity of leaf extract of *Beta vulgaris* by using DPPH ssay

Table: 3 Anti-oxidant activity of leaf extract *Beta vulgaris* by using H2O2 assay

Test	Concentration of plant formulation	% of inhibition for *plant* Extract	% of inhibition for Ascorbic acid
H2O2 assay	20	34	46
	40	55	65
	60	66	76
	80	76	86
IC 50 Value		38	20

Figure: 3 - Anti-oxidant activity of *Beta vulgaris* by using H2O2 assay





In Reducing assay the percentage of inhibition of 45, 55, 65, 75,80 at 20, 40, 60, 80,100 mg/mL concentration respectively and the IC50 value was for *Beta vulgaris* was found to be 28.8mg/ml while for standard drug it was found to be 22.6 mg/ml. The results of reducing assay scavenging activity of this study were similar to the results of the *in vitro* anti-oxidant activity of *Acacia fistula (*16) (Table1 and figure1).

Some of the phytochemical constituents of the *Beta vulgaris* ion extract may be responsible for the anti- oxidant activity as demonstrated in the present study. Flavonoids or bioflavonoids are a ubiquitous group of polyphenolic substances which are present in most plants, concentrated in seeds, fruit skin or peel, bark, and flowers. Numerous studies have shown that flavonoids possess potentanti- oxidant activities capable of scavenging hydroxyl radicals, superoxide anions, and lipid peroxy radicals [17) documented the pharmacological activities (anti-inflammatory, anti-viral, anti-bacterial, anti-ulcer, anti-osteoporotic, anti-allergic, and anti- hepatotoxic actions) of flavonoids for their potent anti-oxidant activity(18).

In the present study, the percentage of scavenging effect on the DPPH• radical was concomitantly increased with the increase in the concentration of both standard and *Beta vulgaris* from 20 to80 mg/mL. The percentage of inhibition was from 45,55,65,75,80 at 20 mg/mL to 100mg/mL for *Beta vulgaris* and the IC50 value for *Beta vulgaris* was 60 mg/ml while for standard it was found to be 8.5 mg/ml (Table 2 & Fig 2).

DPPH is one of the free radicals widely used for testing preliminary radical scavenging activity of the seed extract. Scavenging of DPPH radical is related to the inhibition of lipid peroxidation **(11)**. DPPH is usually used as a substance to evaluate the anti-oxidant activity **(12)**.

The results of the present findings indicated that the DPPH easily accepted the electrons or hydrogen radical from anti-oxidant compounds. When the DPPH had gained the hydrogen atom from the anti-oxidant compounds the colour will be changed. In the present study, the intensity of the colour is directly proportional to the inhibitory activity of the anti-oxidant compound in *Beta vulgaris* ion. It shows the inhibitory activity is due to the maximum hydrogen donating ability of *Beta vulgaris* ion. Based on this result the maximum inhibitory activity is noticed in the aqueous extract at 80mg/mL.

In H_2O_2 assay the percentage of inhibiton of 34, 55, 66 and 76 at 20,40, 60 and 80 mg/mL concentration respectively. The IC50 value for *Beta vulgaris* ion was 38 mg/ml while for standard drug it was found to be 20mg/ml. The result of H_2O_2 scavenging activity of this study is similar to the results of the *in vitro* anti-oxidant activity of *Cinnamomum verum* **(13)**. (Table 3 and figure 3).

The present study proves the inhibition of hydroxyl radical production from H_2O_2 in a dose dependent manner. H_2O_2 can easily penetrate the cell membranes. These molecules will be converted into hydroxyl radicals and damage the cell. The compounds which donated the electrons to H_2O_2 are called anti-oxidants. The donating electron reacts with H_2O_2 and neutralizes it, by converting them into water.

Anti-oxidants are important in the prevention of human diseases. Compounds with anti- oxidants activity may function as free radical scavengers, complexes of pro-oxidant metals, reducing agents, and quenchers of single-oxygen formation or reactive oxygen species, thereby protecting the body from degenerative diseases such as cancer. The reactive oxygen species (ROS) are harmful by products generated during normal cellular metabolism or from toxic insult. They lead to a state of oxidative stress that contributed to the pathogenesis of a number of human diseases by damaging lipids, proteins and DNA **(14).**

Conclusion

From this study it is observed that all the plants posses marked antioxidant effect. The results obtained showed that this plant Beta vulgaris is very important from medicinal point of view, and it

needs further phytochemical exploitation to isolate phytochemical constituents showing antioxidant activity.

Reference

1.A. S. Awaad, R. M. El-Meligy, S. A. Qenawy, A. H. Atta, and G. A. Soliman, "Anti-inflammatory, antinociceptive and antipyretic effects of some desert plants," *Journal of Saudi Chemical Society*, vol. 15, no. 4, pp. 367–373, 2011.

2. T. P. Lalitha and P. Jayanthi, "Preliminary studies on phytochemicals and antimicrobial activity of solvent extracts of *Eichhornia crassipes (Mart.) Solms," Asian Journal of Plant Science & Research*, vol. 2, pp. 115–122, 2012.

3. H. Poulson and S. Preime Loft, "Role of oxidative DNA damage in cancer initiation and promotion," *European Journal of Cancer Preventive*, vol. 7, pp. 9–16, 1998.

4.R. Govindarajan, M. Vijayakumar, and P. Pushpangadan, "Antioxidant approach to disease management and the role of "Rasayana" herbs of Ayurveda," *Journal of Ethnopharmacology*, vol. 99, no. 2, pp. 165–178, 2005.

5. Karyano A, Goswami, P.K. Barooah and J.S. Sandhu. Prospect of Herbal Drug in the age of Globalization-Indian Scenario, vol61, June 2002, pp 423-431.

6. Boudreau, M. D. and Beland, F. A. 2006. An evaluation of the biological and toxicological properties of *Aloe barbadensis* (Miller), Aloe vera. J. Environ. Sci. Health. C Environ. Carcinog. Ecotoxicol. Rev. 24(1):103-154.

7. Rowe, T. D. and Parks, L. M. 1941. Phytochemical study of Aloe vera leaf. J. of the American Pharmaceutical Assoc. 30:262-266.

8. Femenia, A., Sanchez, E. S., Simal, S. and Rossello, C. 1999. Compositional features of polysaccharides from Aloe vera (*Aloe barbadensis* Miller) plant tissues. Carbohydrate Polymers 39:109- 117. 14Henr

9. Rekka E., Kourounakis PN. Effect of hydroxyethyl rutenosides and related compounds on lipid peroxidation and free radical scavenging activity-some structural aspects. J. Pharm Pharmacol. 1991; 43: 486-491.

10.S. Schaffer, S. Schmitt – Schillig, W.E. Müller, G.P. Eckert, Antioxidant Properties Of Mediterranean Food Plant Extracts: Geographical Differences, Journal Of Physiology And Pharmacology, 56, Suppl 1, 115-124, 2005.

11. Tara Chand, Anil Bhandari, Bhupendra K. Kumawat, Pawank Basniwal, Sanjay Sharma, Rajesh Verma. *In vitro* antioxidant activity of alcoholic extract of seed of *Cucumis callosus (Rottl.)* cogn. American Journal of Pharm tech Research. 2012; 2(3): 2249-3387.

12. Choi, S. and Chung, M. H. 2003. A review of the relationship between *Aloe vera* components and their biological effects. Semin. in Integrative Medicine 1:53-62.

14 Alemdar, S. and Agaogln, S. 2009. Investigation of *in vitro* antimicrobial activity of Aloe vera juice. Journal of Animal and Veterinary Advances 8:99-102.

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GCMS Profile of Bioactive Compounds with Therapeutic Potential in *Beta vulgaris* (L.) Ethanolic Leaf Extracts

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Plants, animals, and microorganisms have all been shown to have health benefits for humans. According to World Health Organization, plant medicines continue to be used by 80 percent of the world's population in developing countries. Plant-derived secondary metabolites are macromolecules that are biosynthesized in plants and have a variety of biological properties that are beneficial to humans, including antiallergic, anti-inflammatory, anti-diabetic, and antioxidant properties. Therefore, the present investigation was done to determine the bioactive compounds present in *Beta vulgaris* (L.) leaves powder using Perkin-Elmer Gas Chromatography-Mass Spectrometry, while the mass spectra of the compounds found in the extract matched the National Institute of Standards and Technology (NIST) library. GC-MS analysis of an ethanolic extract of *Beta vulgaris* (L.) revealed the presence of 25 bioactive compounds with different area percentages and structural details. The major bioactive compounds are 1,3,5,7- Tetroxane (73.1%), Decane (83.1%), Azulene (73.8%), 4-Hepten-2-one, 5-ethyl-3,3,4-trimethyl-(71.1%), 6-Amino-1,3,5-triazine-2,4 (1H, 3H)-dione(65.1%), Phthalic acid, 4-bromophenyl ethyl ester(83.7%), Neophtadiene(93.1%), Neophytadiene (88.2%)Hexadecanoic acid, methyl ester(84.8%), n-Hexadecanoic acid(84.3%), Phytol(86.0%), 9- octadecenoic acid, (E)(88.6%), 2-Hexadecen-1-

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ol,3,7,11,15-tetramethyl-acetate,[R-[R*,R*-(E)]]-(64.0%), 1-Tricosene(72.3%) and 17-Pentatriacontene(65.6%). Most identified compounds have bioactivities such as Antimalaria, Anti-inflammatory, Antibacterial, Antifungal, Antiviral, Antidiabetic, Antioxidant, Anticancer, Analgesic, Anti-hyperlipidemic, Hypocholesterolemic, Hepatoprotective, and Anti-androgenic, so that they can be recommended as a plant of phytopharmaceutical importance. Therefore ethanol extract of *Beta vulgaris* (L.) leaves proves as a potential source of bioactive compounds of pharmacological importance.

Keywords: Beta vulgaris L; GC-MS; phytol; azulene; hepatoprotective; antioxidant.

1. INTRODUCTION

It is estimated that 80% of the world's population depends on medicinal plants to treat numerous human diseases. So far nearly 50,000 plant species were screened for medicinal properties [1,2]. Plant-based medicines are currently considered and used as the most common medical system in the world [3]. Plant-based medicine interacts with human biology [4]; hence, safety insurance, quality control, proper usage, observance of reference standards, and efficacy are the valuable components of herbal drug [5]. Herbal medicine, according to WHO, would be a better option for balancing therapeutic services with preventive care which can help to address the unique health challenges of the twenty-first century [6].

According to the World Health Organization, plant-based medicine supports approximately 75-80 percent of the global population, primarily in developing countries such as India, which has a diverse plant-based eco-system [7]. Because of its agro-climate zones, India has always been an opulent reservoir of medicinal plants [8]. In India, plant medicines are usually the first choice for primary healthcare of patients because of better cultural acceptability, better compatibility with the human body, and lesser side effects [9].

Most plants contain bioactive compounds that are known as phytochemicals, such as alkaloids, terpenoids, phenols, glycosides, carotenoids, flavonoids, etc [10-12]. More than 5000 individual phytochemicals have been isolated and identified in fruits, vegetables, and grains [13]. Bioactive compounds is a substance that has positive biological activity in health such as reduction of developing chronic diseases, such as cancer and diabetes [14-16]. Fruits and vegetables are related to these health benefits because they attribute to the synergistic interactions of the bioactive compounds present in the food [17].

The prospect of developing new drugs from natural plants remains appealing because bioactive compounds have alternative and safe effects on treatment [18]. Pharmacopoeia Commission for Medicine & Homoeopathy (PCIM&H) published Pharmacopoeias and formularies for Indian medicinal plants [19]. Practitioners have been using plant medicines extensively for their antioxidant, antiviral, hepatoprotective, immunomodulatory, and thrombolytic activities for ages [20]. Knowledge of the bioactive constituents of plants would further be valuable in discovering folkloric remedies [21].

As a result, the current study investigated the bioactive compounds in the ethanolic extract of *Beta vulgaris* (L.) leaves. Gas Chromatography-Mass Spectroscopy, a hyphenated system, is a widely used technique for identification and quantification. The unknown organic compounds present in a complex mixture can be determined by interpretation as well as by matching the spectra with reference spectra. There are two significant advantages for using GC-MS in the analysis of plant, first, the capillary column in GC-MS has very good separation ability, which can produce a chemical fingerprint of high quality, and second with coupled mass spectral database, quantitative composition information of the plant investigated could be provided by GC-MS, which will be extremely useful for further research for elucidating the relationship between chemical constituents in plant medicine and its pharmacology in further research.

2. MATERIALS AND METHODS

2.1 Collection of Plant Materials

The entire parts of *Beta* vulgaris (L.) are collected from Kothagiri, Nilgiris district, Tamil Nadu, India and were authenticated by Arulanandam, Botanist, The Rapinat Herbarium and Centre for Molecular Systematics, St.Joseph's College, Tiruchirappalli, Tamil Nadu. The herbarium specimens are kept in The Rapinat Herbarium of PG and the Research

Department of Botany, St.Joseph's College, Tiruchirappalli (Tamil Nadu), India.

2.2 Preparation of Plant Extracts

Fresh plants were collected directly from Melvin's organic field, Nilgiris District, (Tamil Nadu), and air-dried at room temperature, and then homogenized to obtain coarse powder. The powdered samples were extracted [22] with ethanol solvent by hot extraction using the Soxhlet apparatus. The solvent-free extracts were collected and stored in a vial (-4°C) for further analysis.

2.3 Gas Chromatography-Mass Spectrometry (GC-MS) Analysis

Ethanolic extract of leaves of *Beta vulgaris* (L.) was analyzed for the presence of different volatile compounds by Gas chromatography-Mass spectroscopy (GC-MS) technique. GC-MS analysis of some of the potent volatile constituents present in the extracts was performed at "Centre for Bioscience and Nanoscience Research (CBNR)", Coimbatore, Tamil Nadu, India. GC-MS analysis of *Beta vulgaris* (L.) leaf ethanolic extracts was performed using a GCMS (Thermo Trace GC Ultra Ver.5.0 ; Model) equipped with DB-35MS fused silica column capillary (length 30m x outside diameter 0.25mm x internal diameter 0.25 µm) and gas chromatograph interfaced to a Mass Selective Detector (MS-DSQ-II) with XCALIBUR software. For GC-MS detection, an electron ionization system with -70 eV ionization energy was used. Helium gas was used as a carrier gas at a constant flow rate of 1 ml/min and the sample injected was 1µl; Injector temperature was 250°C; Ion source temperature was 200°C. The oven temperature was programmed from 70°C to 200°C at the rate of 10°C/min, held isothermal for 1 minute and finally raised to 250°C at 10°C/min. The interface temperature was kept at 250°C. The relative percentage of *Beta vulgaris* (L.) leaf extract constituent was expressed as a percentage showing peak area normalization.

2.4 Identification of Components

The components identified in the *Beta vulgaris* (L.) leaf ethanolic extract were assigned by their comparison of the retention time and mass spectra fragmentation patterns with those stored in the computer library and also with published literature. NIST [23,24] library sources were also used for matching the identified components from plant extract materials.

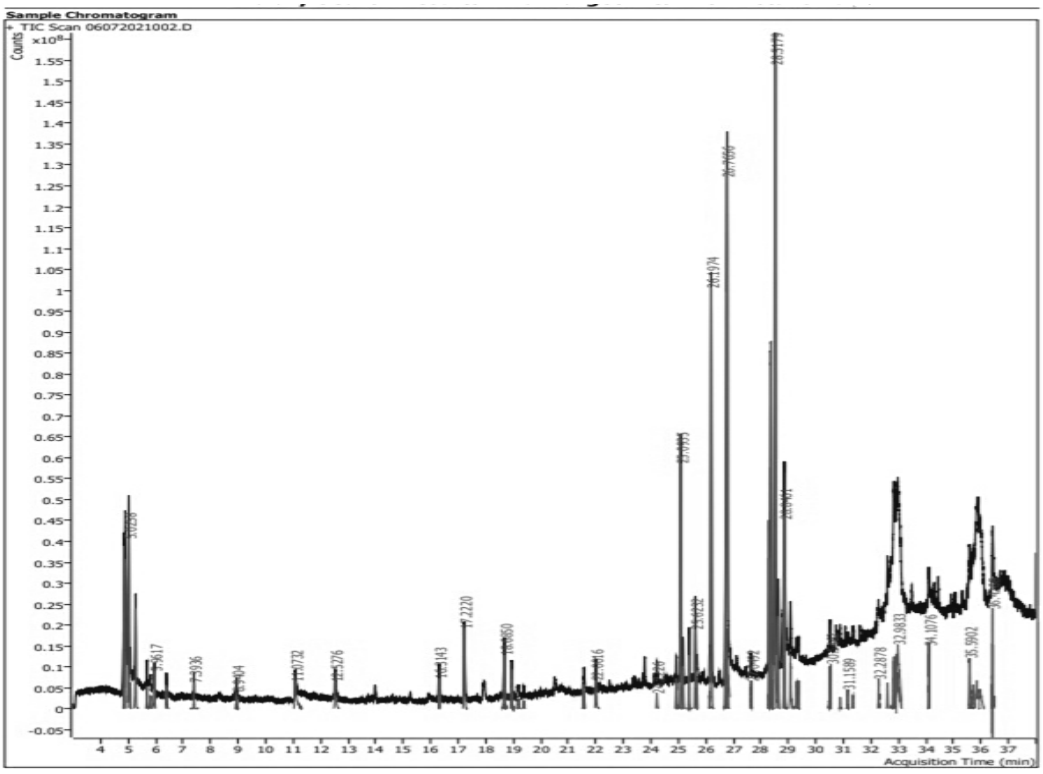

Fig. 1. Chromatogram of ethanolic extract of *Beta vulgaris* (L) leaf

3. RESULTS AND DISCUSSION

The GC-MS analysis of ethanolic extracts of leaves of *Beta vulgaris* (L.) revealed the presence of twenty-five constituents. The GC-MS running time was 37.15 minutes. The GC-MS chromatogram is presented in Fig.1. Table 1 shows the active principles along with their Retention Time (RT), Molecular Formula, Molecular Weight (MW), and peak area. The identified leaf extract compound's spectra are compared to the Wiley 9.0 and NIST libraries.

The major identified bioactive compounds and its peak area are 1,3,5,7- Tetroxane (73.1%); Decane (83.1%); Azulene (73.8%); 4-Hepten-2-one, 5-ethyl-3,3,4-trimethyl-(71.1%); 6-Amino-1,3,5-triazine-2,4 (1H, 3H)-dione(65.1%); Phthalic acid, 4-bromophenyl ethyl ester(83.7%); Neophtadiene(93.1%); Neophytadiene (88.2%); Hexadecanoic acid, methyl ester(84.8%); n-Hexadecanoic acid(84.3%); Phytol(86.0%); 9-octadecenoic acid, (E)(88.6%); 2-Hexadecen-1-ol,3,7,11,15-tetramethyl-acetate,[R-[R*,R*-(E)]]-(64.0%); 1-Tricosene(72.3%) and 17-Pentatriacontene(65.6%) were also obtained. The nature and uses of the phytoconstituents in ethanol extract of *Beta vulgaris.*L leaf are presented in Table 2.

Among the identified compounds, 4-Hepten-2-one, 5-ethyl-3,3,4-trimethyl, Neophytadiene, Hexadecanoic acid, methyl ester, n-Hexadecanoic acid, 2-Hexadecen-1-ol,3,7,11,15-tetramethyl-actetate [R-[R*,R*-(E)] have the property of antioxidant, antimicrobial, anti-inflammatory. n-Hexadecanoic as the common compound in the leaves of *P.stratiotes* and *E.crassipes.* E-11-Hexadecanoic acid, ethyl ester act as Antifungal, Antitumour, Anti-bacterial, and Hexadecanoic acid, 2-hydroxyl-1-(hydroxymethyl) ethyl ester found in leaf extract act as Hemolytic, pesticide, flavor, antioxidant [25]. Similarly, work on the bioactivity of n-hexadecanoic acid (also known as palmitic acid) and reported that it possesses strong antioxidant properties and pesticidal activity [26]. 1,3,5,7-Tetroxane reported having antimalarial, antipyretic, or anti-inflammatory agents. Similarly, the presence of 1,3,5,7-Tetroxane was observed in the methanolic extract of *Jatropha curcas* (L.) [27]. Azulene is reported to being effective in the treatment of Antibacterial, Antifungal, Anticancer, Analgesic, Anti-inflammatory, Anti-diabetic, Anti-hyperlipidemic, Anti-tubular activity. Neophytadiene reported antipyretic, analgesic, anti-inflammatory, anti-microbial, antioxidant. Similarly, the Azulene compound is found in GCMS hydrosol extract of *Aquilaria* (Agarwood) species [28]. Phytol showed Antimicrobial, anti-inflammatory, diuretic, anticancer, antimalarial. Phytol was found to give good, well preventive, and therapeutic results against arthritis. The results showed reactive oxygen species promoting a novel class of pharmaceuticals for the treatment of rheumatoid arthritis and possibly

Table 1. GC-MS Analysis of bioactive compounds in the leaves of ethanolic extract of *Beta vulgaris* L

S.No	Retention Time	Name of the compound	Molecular Formula	Molecular Weight (g/mol)	Peak Area
1	5.02	1,3,5,7-Tetroxane	$C_4H_8O_4$	120.10	73.1%
2	7.39	Decane	$C_{10}H_{22}$	142.29	83.1%
3	11.07	Azulene	$C_{10}H_8$	128.17	73.8%
4	17.22	4-Hepten-2-one, 5-ethyl-3,3,4-trimethyl-	$C_{12}H_{22}O$	182.30	71.7%
5	18.68	6-Amino-1,3,5-triazine-2,4(1H,3H)-dione	$C_3H_4N_4O_2$	128.09	65.1%
6	22.00	Phthalic acid, 4-bromophenyl ethyl ester	$C_{16}H_{13}BrO_4$	349.17	83.7%
7	25.09	Neophytadiene	$C_{20}H_{38}$	278.5	93.1%
8	25.62	Neophytadiene	$C_{20}H_{38}$	278.5	88.2%
9	26.19	Hexadecanoic acid, methyl ester	$C_{17}H_{34}O_2$	270.45	84.8%
10	26.76	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	256.42	84.3%
11	28.51	Phytol	$C_{20}H_{40}O$	296.53	86.0%
12	28.84	9-Octadecenoic acid, (E)-	$C_{19}H_{36}O$	296.48	88.6%
13	30.51	2-Hexadecen-1-ol,3,7,11,15-tetramethyl-,acetate, [R-[R*,R*-(E)]-	$C_{20}H_{40}O$	296.53	64.0%
14	32.28	1-Tricosene	$C_{23}H_{46}$	322.6	72.3%
15	34.10	17-Pentatriacontene	$C_{35}H_{70}$	490.9	65.6%

Table 2. Nature and the biological activities of phytoconstituents of the leaves of ethanolic extract of *Beta vulgaris* (L.)

S.No	Retention Time	Name of the Compound	Compound Nature	Uses
1	5.02	1,3,5,7-Tetroxane	Hetero compound, Oxane	Antimalaria, non-central analgesic, antipyretic, antiinflammatory
2	7.39	Decane	Alkanes hydrocarbon	Antibacterial, neurotropic
3	11.07	Azulene	Aromatic hydrocarbon	Anti-inflammatory, antineoplastic, antidiabetes, antiretroviral, antimicrobial, antifungal
4	17.22	4-Hepten-2-one, 5-ethyl-3,3,4-trimethyl-	Ketone	Antioxidant, Antimicrobial-Antibacterial
5	18.68	6-Amino-1,3,5-triazine-2,4(1H,3H)-dione	Amino diol	Antibacterial, Antifungal, Anticancer, Analgesic, Anti-inflammatory, Antidiabetic, Antihyperlipidemic, Anti tubular activity
6	22.00	Phthalic acid, 4-bromophenyl ethyl ester	Acid	Antibacterial activity, Antifungal activity
7	25.09	Neophytadiene	Hydrocarbons	Antipyretic, Analgesic, anti-microbial, Antioxidant, Anti-inflammatory,
8	25.62	Neophytadiene	Hydrocarbons	Antipyretic, Analgesic, Anti-inflammatory, Anti-microbial. Antioxidant
9	26.19	Hexadecanoic acid, methyl ester	Amino compound	Antioxidant, nematicide, flavoring agent, pesticide, anti-androgenic,hypocholesterolemic, lubricant
10	26.76	n-Hexadecanoic acid	Palmitic acid ester	Antioxidant, hypocholesterolemic, antiandrogenic, hemolytic, lubricant
11	28.51	Phytol	Diterpene	Antimicrobial, anti-inflammatory, Antifungal against *S.typhi,* resistant gonorrhea, diuretic, headache, hernia, anticancer, resistant gonorrhea, joint dislocation, stimulant, and antimalarial
12	28.84	9-Octadecenoic acid, (E)-	Polyenoic fatty acid	Hepatoprotective, antihistaminic, hypocholesterolemic, antiviral, anti-eczemic
13	30.51	2-Hexadecen-1-ol,3,7,11,15-tetramethyl-,acetate, [R-[R*,R*-(E)]-	Alkanes	Antioxidant, Hemolytic, Hypocholeserolemic, flavor, nematicide, anti-androgenic, antibacterial, antifungal
14	32.28	1-Tricosene	Alkene	Anticancer, Anti-inflammatory
15	34.10	17-Pentatriacontene	Alkene	Antimicrobial, Anti-inflammatory, Anticancer

other chronic inflammatory diseases [29]. 1-Tricosene and 17-Pentatriacontene showed anti-cancer, anti-inflammatory, and anti-cancer activity. The Pesticidal potential of 1-tricosene, (Z)-and [1,1' – bicyclopropyl]-2-octanoic acid,

2'hexy10 methyl ester was reported by Verma et al. [30].

Several other compounds with notable medicinal properties were also detected using the GCMS chromatogram. The aforementioned compounds found in the ethanol extract of *Beta vulgaris* (L.) leaf can be used in pharmacological research. Thus, GC-MS analysis of plant extracts is the first step toward understanding the nature of active components found in medicinal plants. This type of research will be useful for future research on plant medicinal active constituents. Separating individual secondary metabolites and subjecting them to biological activity, on the other hand, will yield fruitful results in the future. It could be concluded that *Beta vulgaris* (L.) leaf contains various bioactive compounds. So it is recommended as a leaf of pharmaceutical importance. However, further studies are needed to be done to undertake its bioactivity and toxicity profile.

4. CONCLUSION

GC-MS analysis of an ethanol extract of *Beta vulgaris* (L.) leaf revealed the presence of secondary metabolites with anticancer, antimicrobial, antioxidant, analgesic, anti-androgenic, and anti-inflammatory activities, suggesting a potential industrial application. We concluded that the biological values of *Beta vulgaris* (L.) contain pharmacologically active compounds that may improve its use of modern plant-based drugs.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Saslis-Lagoudakis CH, Hawkins JA, Greenhiss SJ, Pendry CA, Watson MF, Tuladhar-Douglas W et al. The evolution of traditional knowledge: Environment shapes medicinal plant use in Nepal. Proc Royal Soc B: Bol Sci. 2014;281(1780):20132768.
2. Chen S, Yu H, Luo H, Wu Q, Li CF, Steinmetz. Conservation and sustainable use of medicinal plants: problems, progress, and prospects. Chin Med. 2016; 11:37.
3. Origima SAO. Web-based decision support system for prescription in herbal medicine. J Emerg Trends Eng Appl Sci. 2015; 6(7):245-254.
4. Motahari Tabari N, Yousefi SS, Heydarirad G, Kardan Soraki M, Habibipour P. Exercise from the perspective of Iranian traditional medicine. J.Evid Based Complementary Altern Med. 2017;22(2): 344-346.
5. Boulin AS, Wierer M. Quality standards of the European Pharmacopoeia. J. Ethnopharmacol. 2014;158:454-457.
6. WHO global report on traditional and complementary medicine. World Health Organization; 2019.
7. Evans M. A Guide of Herbal Remedies, Orient Paperbacks: Delhi, India; 1994. ISBN – 10:8122201628.
8. Mohanraj K, et al. IMPPAT: A curated database of Indian Medicinal Plants, Phytochemisty and Therapeutics. Sci. Rep. 2018;8:4329-4346.
9. Patel DK, Prasad SK, Kumar R, Hemalatha S. An overview on antidiabetic medicinal plants having insulin mimetic property. Asian Pac.J.Trop.Biomed. 2012;2: 320-330.
10. Malviya N. Antidiabetic Potential of Medicinal Plants. Acta Pol. Pharma. 2010; 67:113-118.
11. Grover JK, Yadav S, Vats V. Medicinal plants of India with anti-diabetic potential. J. Ethnopharmocol. 2002;81:81-100.
12. Aggarwal N, Aggarwar S. A review of recent investigations on Medicinal Herbs possessing antidiabetic properties. J.Nutr. Disord. Ther; 2011.
13. Liu RH. Dietary bioactive compounds and their health implications. J.Food Sci. 2013; 78:A18-A25.
14. Hoboken NJ. Dictionary of Food Science and Technology, 2nd ed, International Food Information Service

(Ed), John & Wiley & Sons: Hoboken, NJ, USA. 2009;47-48.
15. Reiss R, Johnston J, Tucker K, DeSesso JM, KeenCL. Estimation of cancer risks and benefits associated with a potential increased consumption of fruits and vegetables. Food Chem. Toxicol. 2012;50:4421-4427.
16. Salvin JL, Lloyd B. Health benefits of fruits and vegetables. Adv. Nutri. 2012;3:506-516.
17. Rodriguez-Casado A. The health potential of fruits and vegetables phytochemicals: Notable examples. Crit. Rev. Food Sci. 2014;56:1097-1107.
18. Kayarohanam S, Kavimani S. Current trends of plants having antidiabetic activity: A Review.J.Bioanal.Biomed. 2015;7:55-65.
19. Pharmacopoeia commission for Indian medicine & Homoeopathy, Ministry of AYUSH. Government of India.
20. Arora R, Chawla R, Marwah R, Arora P, Sharma RK, Kaushik V, Bhardwaj JR. Potential of Complementary and Alternative Medicine in Preventive Management of Novel H1N1 Flu (Swine Flu) Pandemic: Thwarting Potential Disasters in the Bud. Evidence-Based Complementary and Alternative Medicine, eCAM. 2011;586506.
21. Mojab F, Kamalinejad M, Ghanderi N, Vahidipour HR. Phytochemical screening of some species of Iranian plants. Iranian Journal of Pharmaceutical Research. 2003;2(2):77-82.
22. Mukherjee PK. Quality Control of Herbal Drugs. An approaches to evaluation of botanicals, edition 1st Business Horizons, New Delhi. 2002;390-403.
23. Mc Lafferly FW. Registry of mass spectral data, 5ed, Wiley New York; John Wiley & Sons Inc; 1989.
24. Stein SE. National Institute of Standards and Technology (NIST) Mass Spectral Database and Software, Version 3.02 Gaithersburg, Md USA; 1990.
25. Duke's Phytochemical and Ethnobotanical Databases U.S, Department of Agriculture, Agricultural Research Service 1992-1996 [online].
26. Mohmoud HO, Dardiry Amal AA. Mohamed, Eman Abdelrady. Effect of lead (Pb) on phytochemical variability of *Jatropha curcas* (L.): A versatile perennial of Euphorbiaceae family, 2018;1(3):133-145.
27. Pavithra KS, Annadurai J, Ragunathan R. Phytochemical, antioxidant and a study of bioactive compounds from Artemisia pollens.J.Pharm Phytochem. 2018;7:664-675.
28. Yumi Zuhanis Has-Yun Hashim, Natasha Jafar Ali, Nur Aimi Aliah Zainurin, Phirdaous Abbas. Profiling of compounds in Hydrosol extract of Aquilaria (Agarwood) species using Gas Chromatography-Mass Spectrometry (GCMS), Biological and Natural Resources Engineering Journal. 2021;5(1):25-33.
29. Ogunlesi M, Okiei W, Ofor E, Osibote AE. Analysis of the essential oil from the dried leaves of Euphorbia hirta Linn (Euphorbiaceae), a potential medication for asthma. African.J.Biotech. 2009;8:7042-7050.
30. Verma VP, SH Kumar, KV Rani, N Sehgal, O Prakash. Compound profiling in methanol extract of *Kalanchoe blossfeldiana* (flaming katy) leaves through GC-MS analysis and evaluation of its bioactive properties. Glob J Adv Biol Sci. 2015;1:38-49.

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