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Phytochemical Profiling of *Erythrina variegata* Leaves by Gas Chromatography-mass Spectroscopy

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ABSTRACT

Background: Biologically active compounds derived from the many of medicinal plants have become an important source for developing natural products to act as an antioxidant, insecticidal, antimicrobial and antifungal properties. So the current work was aimed to determine the bioactive components present in the leaves of *Erythrina variegata* by using GC-MS analysis to assess the antioxidant, insecticidal, antimicrobial and antifungal properties.

Methods: The laboratory experiment was carried out at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore during 2019-2020 to ascertain the phytochemical extraction using different solvents, *viz.,* water, ethanol and hexane by GC-MS analysis of the leaves of *Erythrina variegata.*

Result: GC-MS analysis of aqueous, ethanol and hexane leaf extracts revealed the presence of twenty four, twenty six and twenty two components, respectively. Of the twenty four compounds eluted from the aqueous leaf extract, 9,12-Octadecadienoic acid (Z,Z)-, 2-hydroxy-1-(hydroxymethyl)ethyl ester had the highest peak area of 11.98%, while the lowest was 0.33 % for oleic acid,eicosyl ester and 1,2,3-butanetriol. In the ethanol leaf extract diethyl phthalate had the highest peak area of 35.04% and d-streptamine, O-6-amino-6-deoxy-à-D-glucopyranosyl- (1-4)-O- (3-deoxy-4-C-methyl-3- (methylamino) -á-L-arabinopyranosyl- (1-6) -2-deoxy-with the lowest peak area of 0.40%. Whereas, phenol,2,6-bis (1,1-dimethyl ethyl)- and dasycarpidan-1-methanol, acetate (ester) had the the lowest peak area of 0.20% and 9-octadecenoic acid (Z)-, 2,3-dihydroxypropyl ester exhibited the highest peak area of 13.41%, respectively, in the hexane leaf extract. The results of the present study clearly indicated that the leaf extract of *Erythrina variegata* possesses potent antioxidant, antibacterial, antifungal, antimicrobial, pesticide, insecticide, insect repellent, larvicidal activity, antibiotic, free radical scavenger, peroxidase substrate, reductant, lipid peroxidase inhibitor, plasticizer, surfactant and emulsifying properties.

Key words: *Erythrina variegata*, GC-MS, Leaf extract, Phytochemical, Profiling.

INTRODUCTION

Biologically active compounds derived from plants have become an important source of drugs due to the increasing recognition of herbal medicine as an alternative form of health care (Afolayan *et al.,* 2008). Numerous plants contain a range of phytopharmaceuticals, which have been shown to have significant uses in agriculture, human and veterinary medicine and the prevention of disease (Newman *et al.,* 2003). Plant components have been used as a key source of medicine from ancient times and have been the primary source of drugs in Indian systems of medicine and other ancient systems across the world (Devi *et al.,* 2011). Phytochemicals are the naturally occurring bioactive substances found in plants and the most substantial bioactive constituents of plants are alkaloids, tannins, flavonoids, steroids, terpenoids, carbohydrates and phenolic compounds (Sowmya *et al.,* 2015).

"*Erythrina variegata*" L. (Fabaceae) also known as tiger's claw, indian coral tree, farad and parijata is a species of *Erythrina* that is indigenous to the tropical and subtropical areas of the Indian subcontinent. In India, its leaves are generally utilized for curing (Kumar *et al.,* 2011). According to a previous study on the same species of plant contains hepatoprotective and anti-leprosy properties. Its extract has been shown to have sedative, antidiuretic, antioxidant and antihyperlipidemic activities (Hemmalakshmi *et al.,* 2017). *Erythrina variegata* leaves, bark and root are used in India for the treatment of various diseases *viz*., as antioxidant activity, antiosteoporotic, anthelmintic, antiulcer, diuretic, analgesic, cytotoxic, cardiovascular effect and respiratory effect (Baranitharan *et al.,* 2019). However, there haven't been many thorough, scientific investigations on the

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phytochemical screening and isolation of secondary metabolites in *Erythrina variegata*.

Antioxidant activity has been proposed to play roles in various pharmacological activities such as anti-aging, anti-inflammatory, anti-atherosclerosis and anti-cancer activities. Inhibition of free radical-induced damage by supplementation of antioxidants has become an attractive therapeutic strategy for reducing the risk of diseases (Sakat and Juvekar, 2010). Although there are many synthetic antioxidants, they are quite unsafe and their toxicity is of concern (Sakat and Juvekar, 2010). It is possible to employ natural products in place of synthetic ones if they have antioxidant, antifungal, antibacterial, antimicrobial and insecticidal properties. Due to their usefulness, low toxicity to vertebrates and great biodegradability, plant-borne compounds have received significant attention in recent years as potential replacements for synthetic ones (Baranitharan *et al.,* 2019). The bioactive chemicals found in plants can be exploited to create ecologically friendly vector and pest management products.

In order to explore the antioxidant, antifungal, antibacterial, antimicrobial and insecticidal activity using various solvents including aqueous, ethanol and hexane extracts obtained from *Erythrina variegata* leaves, the current work was done. GC-MS analysis was used to identify the phyto-components present in the extract in order to assess the medicinal characteristics of the plant.

MATERIALS AND METHODS

The laboratory experiment was carried out at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore during 2019-2020. Fresh matured leaves of *Erythrina variegata* were obtained from Agricultural Engineering College and Research Institute, Kumulur, *Tiruchirappalli,* Tamil Nadu, India were used as the base leaf material for this study.

Preparation of extraction

The collected *Erythrina variegata* leaves were washed well with distilled water and shade dried at room temperature. The dried leaves were ground into fine powder in an electric blender. From the powdered leaf material, the extracts were prepared using solvents such as water, ethanol and hexane. The water, ethanol and hexane extracts were prepared by mixing twenty-five grams of powdered leaves in 250 mL of water, ethanol and hexane were taken separately in 1:10 w/v. Then it was shaken for 48 hours at a speed of 190 to 220 rpm. The extracts were filtered through Whatman No.1 filter paper and collected in brown bottles separately. Following that, the different extract solvents were evaporated by Rota-vapour sepearately, where the water bath's temperature was maintained at 40°C and then lyophilized by lyophilizer which gave rise to a solid mass of the extract. The solid mass was refrigerated under -20°C until it was used for the GC-MS analysis (Preeti and Chandrawati, 2017); (Suriyavathana *et al.,* 2016); (Hemmalakshmi *et al.,* 2016).

GC-MS Analysis of leaf extracts

GC-MS analysis of leaf extracts was carried out by following the method of Hema *et al.* (2010).The Perkin-Elmer GC Clarus 500 system, Agilent Co., USA. and a Gas Chromato graph Interfaced to a Mass Spectrometer (GC-MS) equipped with an Elite-I, fused silica capillary column (30 mm × 0.25 mm 1D × 1 µMdf, formed of 100% Dimethyl polysiloxane) were used to conduct the GC-MS analysis of the extract. An electron ionization device with an ionising energy of 70 eV was employed for GC-MS detection. The carrier gas, helium (99.999%), was utilized with an injection volume of 2ìl and a constant flow rate of 1 ml/min (split ratio: 10:1); 250°C for the injector and 280°C for the ion source. The oven temperature was configured to begin at 110°C (isothermal for 2 minutes), rise at a rate of 10°C/min to 200°C, then 5°C/min to 280°C and ending with a 9 minute isothermal at 280°C. At 70 eV, 0.5 seconds of scanning time and fragments ranging in size from 45 to 450 Da, mass spectra were recorded. The GC ran for 36 minutes in total. The software used to handle mass spectra and chromatograms was called Turbomass and it was utilized to compute the relative percent amount of each component by comparing its average peak area to the total areas.

Identification of components

The National Institute of Standard and Technology (NIST) database, which contains more than 62,000 patterns, was used for the GC-MS experiment. For the interpretation of the mass spectrum, comparison was made between the spectra of the unknown component and the spectrum of the known components in the NIST collection.

RESULTS AND DISSCUSSION

The extracted *Erythrina variegata* leaves samples were analyzed with GC-MS to detect phyto-components. Based on their specific retention time, probability and peak area %, chemical compounds were identified and quantified using the GC-MS technique. A wide range of compounds were identified by GC-MS, as shown in Table. 1 (aqueous leaf extract), Table 2 (ethanol leaf extract) and Table. 3 (hexane leaf extract). The compound prediction is based on National Institute Standard and Technology Database (Table 1, 2 and 3).

The results revealed that, in aqueous leaf extract presence of 17-octadecynoic acid (1.52%), hexadecanoic acid, methyl ester (1.10%), methyl 9-cis,11-trans-octadecadienoate (1.03%), 11-octadecenoic acid, methyl ester (1.22%), dasycarpidan-1-methanol, acetate (ester) (1.08%), 9-octadecenamide, (Z)- (1.29%), oleic Acid (1.23%), 9,12-octadecadienoic acid (Z,Z)-, 2-hydroxy-1-(hydroxymethyl) ethyl ester (11.98%), 9-octadecenoic acid (Z)-, 2,3-dihydroxy propyl ester (3.30%), 9-octadecenoic acid (Z)-, 2-hydroxy-1- hydroxymethyl) ethyl ester (8.75%). The spectrum profile of GC-MS confirmed the presence of ten major components with the retention time 15.5, 21.1, 24.2, 24.4, 25.5, 25.7, 25.9, 29.1, 29.3 and 29.5 respectively (Table 1 and Fig 1).

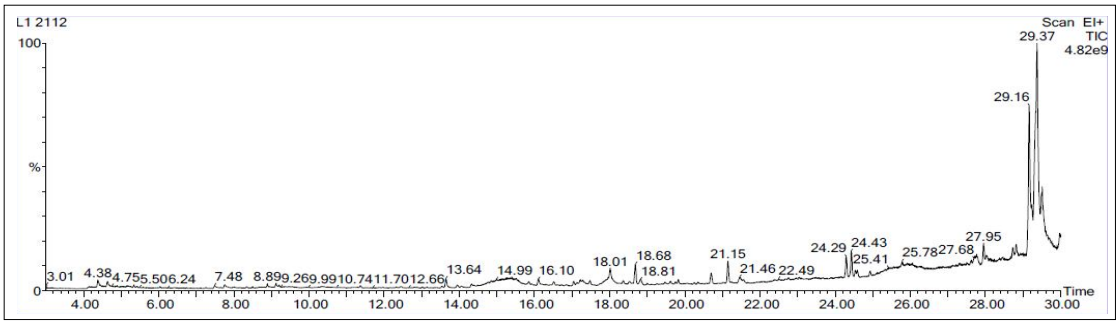

Fig 1: GC-MS chromatogram of aqueous leaf extract of *Erythrina variegate*.

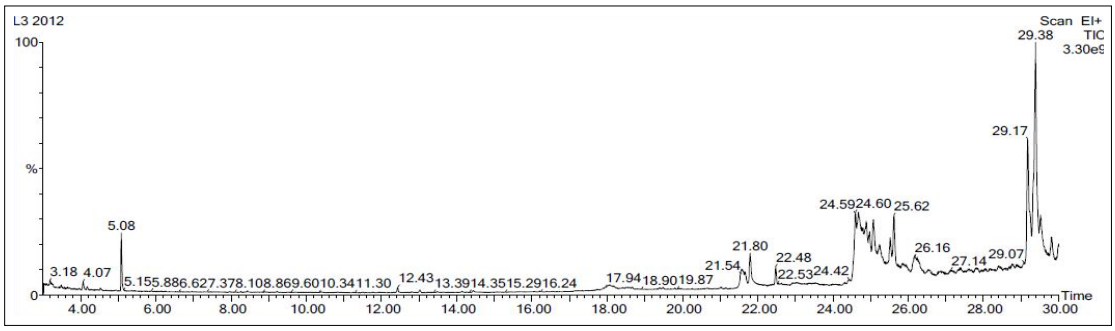

Fig 2: GC-MS chromatogram of ethanol leaf extract of *Erythrina variegate*.

Table 1: Phytochemical compounds identified in aqueous extract of *Erythrina variegata* leaves.

RT	Compound	Probability	Area %
3.1	4- (2-Aminoethyl)benzenesulfonyl fluoride	28.6	0.45
4.6	1,2,3-Butanetriol	63.9	0.33
14.9	Melezitose	7.3	0.81
15.5	17-Octadecynoic acid	7.0	1.52
16.1	Xylitol, 1-O-octanoyl-	21.4	0.55
17.2	6-Hydroxy-4,4,7a-trimethyl-5,6,7,7a-tetrahydrobenzofuran-2(4H)-one	73.5	0.43
18.6	5H-Inden-5-one, 1,2,3,6,7,7a-hexahydro-7a-methyl-	9.0	0.99
18.8	Spiro[4.5]decan-7-one, 1,8-dimethyl-8,9-epoxy-4-isopropyl-	18.8	0.41
20.7	7-Oxabicyclo [4.1.0] heptan-3-ol, 6- (3-hydroxy-1-butenyl) -1,5,5-trimethyl-	19.5	0.63
21.1	Hexadecanoic acid, methyl ester	73.3	1.10
21.4	9-Octadecene, 1-methoxy-, (E)-	10.2	0.52
24.2	Methyl 9-cis,11-trans-octadecadienoate	13.4	1.03
24.4	11-Octadecenoic acid, methyl ester	6.6	1.22
25.3	9-Hexadecenoic acid	11.1	0.82
25.5	Dasycarpidan-1-methanol, acetate (ester)	6.8	1.08
25.7	9-Octadecenamide, (Z)-	49	1.29
25.9	Oleic Acid	17.8	1.23
26.0	9-Octadecenoic acid (Z)-, tetradecyl ester	5.2	0.81
26.3	Oleic acid, eicosyl ester	5.4	0.33
27.7	Squalene	12.9	0.64
29.1	9,12-Octadecadienoic acid (Z,Z)-, 2-hydroxy-1- (hydroxymethyl) ethyl ester	26.2	11.98
29.3	9-Octadecenoic acid (Z)-, 2,3-dihydroxypropyl ester	17.5	3.30
29.5	9-Octadecenoic acid (Z)-, 2-hydroxy-1- (hydroxymethyl) ethyl ester	9.2	8.75
29.7	2H-Pyran, tetrahydro-2- (12-pentadecynyloxy)-	6.7	0.52

Table 2: Phytochemical compounds identified in ethanol extract of *Erythrina variegata* leaves.

RT	Compound	Probability	Area %
3.3	Maleic anhydride	26.5	0.43
4.7	1,2,3-Butanetriol	60.5	1.90
6.1	1-Butanol, 3-methyl-, formate	30.9	0.94
11.9	Bisacodyl	71.7	0.56
13.0	2(4H)-Benzofuranone, 5,6,7,7a-tetrahydro-4,4,7a-trimethyl-, (R)-	74.8	0.41
13.8	Propanoic acid, 3,3,3-trifluoro-2- [(3-trifluoromethyl-2-quinoxalinyl) amino]-2- [(4-methoxybenzoyl) amino]-, ethyle ester	20.5	0.79
14.2	Diethyl Phthalate	85.7	35.04
15.8	7-Oxabicyclo[4.1.0]heptan-3-ol, 6-(3-hydroxy-1-butenyl)-1,5,5- trimethyl-	91.3	0.77
17.9	6-Hydroxy-4,4,7a-trimethyl-5,6,7,7a-tetrahydrobenzofuran-2(4H)-one	86.2	2.16
18.3	4-Hydroxy-á-ionone	13	0.52
21.4	D-Streptamine, O-6-amino-6-deoxy-à-D-glucopyranosyl-(1-4)-O- (3-deoxy -4-C-methyl-3-(methylamino)-á-L-arabinopyranosyl-(1-6))-2-deoxy-	16.6	0.40
21.8	n-Hexadecanoic acid	76.3	1.85
22.2	trans-Sinapyl alcohol	73.9	0.57
22.5	à-D-Glucopyranose, 4-O-á-D-galactopyranosyl-	7.1	0.90
22.7	Boronic acid, ethyl-, dimethyl ester	17.7	0.42
22.8	Isopropyl palmitate	9.2	0.53
22.9	Cartap	40.3	0.46
23.0	Z- (13,14-Epoxy) tetradec-11-en-1-ol acetate	12.3	0.51
23.1	Muco-Inositol	12.8	0.49
23.3	Allo-Inositol	14.1	0.69
23.4	Formononetin	54.7	0.50
23.6	Eicosanoic acid	4.6	1.73
24.9	9,12-Octadecadienoic acid (Z,Z)-	33.9	0.64
25.0	9,12,15-Octadecatrienoic acid, (Z,Z,Z)-	41.6	3.45
29.1	9,12-Octadecadienoic acid (Z,Z)-, 2-hydroxy-1- (hydroxymethyl) ethyl ester	25.2	1.55
29.3	9-Octadecenoic acid (Z)-, 2,3-dihydroxypropyl ester	28.2	2.12

Table 3: Phytochemical compounds identified in hexane extract of *Erythrina variegata* leaves.

RT	Compound	Probability	Area %
4.0	Oxirane, butyl-	13.7	0.32
5.0	2-Pyrrolidinone, 1-methyl-	92.9	1.56
12.4	Phenol, 2,6-bis (1,1-dimethylethyl)-	39.3	0.20
18.0	Hexadecanoic acid, 2-hydroxy-1- (hydroxymethyl) ethyl ester	35.9	1.83
18.4	Hexadecanoic acid, 1- (hydroxymethyl) -1,2-ethanediyl ester	40.1	0.41
18.6	Heptadecane, 9-hexyl-	25.5	0.25
21.7	n-Hexadecanoic acid	70.9	2.78
22.4	Hexadecanoic acid, ethyl ester	63.1	0.80
24.4	Oxiraneundecanoic acid, 3-pentyl-, methyl ester, cis-	7.6	0.29
24.9	9,12-Octadecadienoic acid (Z,Z)-	10.2	3.20
25.0	9,12,15-Octadecatrienoic acid, (Z,Z,Z)-	36.7	5.44
25.5	9,12-Octadecadienoic acid, ethyl ester	12.2	3.44
25.6	9,12,15-Octadecatrienoic acid, ethyl ester, (Z,Z,Z)-	27.5	4.43
25.8	Oleic Acid	19.6	0.95
26.3	Dasycarpidan-1-methanol, acetate (ester)	23.9	0.20
27.6	Oleic acid, eicosyl ester	8.8	0.32
27.8	Ethyl iso-allocholate	27.8	0.27
28.7	Z-10-Methyl-11-tetradecen-1-ol propionate	20.2	0.38
28.8	2-Nonadecanone 2,4-dinitrophenylhydrazine	11	0.20
29.1	9,12-Octadecadienoic acid (Z,Z)-, 2-hydroxy-1- (hydroxymethyl) ethyl ester	48.8	6.84
29.3	9-Octadecenoic acid (Z)-, 2,3-dihydroxypropyl ester	17.4	13.41
29.7	Tetratetracontane	7.1	1.07

The ethanolic leaf extract showed the presence of eight major different organic compounds. The major phytochemical compounds among them were 1,2,3-butanetriol (1.90%), diethyl phthalate (35.04%), 6-hydroxy-4,4,7a-trimethyl-5,6,7,7a-tetrahydro benzofuran-2(4H)-one (2.16%), n-hexadecanoic acid (1.85%), eicosanoic acid (1.73%), 9, 12, 15-octadecatrienoic acid, (Z,Z,Z)- (3.45%), 9,12-octadecadienoic acid (Z,Z)-, 2-hydroxy-1- (hydroxymethyl) ethyl ester (1.55%), 9-octadecenoic acid (Z)-, 2,3-dihydroxy propyl ester (2.12%) with the retention time of 4.7, 14.2, 17.9, 21.8, 23.6, 25.0, 29.1 and 29.3 respectively (Table 2 and Fig 2).

Whereas, the most prevailing nine major compounds present in the hexane leaf extract were 2-pyrrolidinone, 1-methyl- (1.56%), hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester (1.83%), n-hexadecanoic acid (2.78%), 9,12-octadecadienoic acid (Z,Z)- (3.20%), 9,12,15-octadecatrienoic acid, (Z,Z,Z)- (5.44%), 9,12-octadecadienoic acid, ethyl ester (3.44%), 9,12,15-octadecatrienoic acid, ethyl ester, (Z,Z,Z)- (4.43%), 9,12-octadecadienoic acid (Z,Z), 2-hydroxy-1-(hydroxymethyl) ethyl ester (6.84%), 9-octadecenoic acid (Z)-, 2,3-dihydroxypropyl ester (13.41%), tetratetracontane (1.07%) confirmed with the retention time of 5.0, 18.0, 21.7, 24.9, 25.0, 25.5, 25.6, 29.1, 29.3 and 29.7 respectively (Table 3 and Fig 3).

The gas chromatogram shows that the relative concentrations of various compounds are getting eluted as a function of retention time. Peak heights indicated the relative amounts of the chemicals found in the plant. To determine the kind and structure of the compounds, the mass spectrometer examines the compounds eluted at different times.

In general, the effectiveness of medicinal plants is assessed by correlating the phytochemical compounds to the biological activities of the plants (Belkacem *et al.,* 2013). In the current investigation, the GC-MS analysis of the leaf extracts of *Erythrina variegata* in water, ethanol and hexane revealed the presence of 24, 26 and 22 chemicals, respectively. In this account, the aqueous, ethanol and hexane leaf extract contained ten, eight and nine major components having antioxidant, nematicide, pesticide insecticidal, larvicidal, insect repellent, antimicrobial, antibacterial and antifungal activities, 5-alpha reductase inhibitor, hemolytic, alpha-glucosidase inhibitors activity, free radical scavenger, peroxidase substrate, reductant and lipid peroxidase inhibitor, plasticizer, surfactant and emulsifying properties, anticancer activity, hypocholesterolemic, hepatoprotective and cytoprotective activities (Table 4, 5 and 6), had very important medicinal values as shown. This plant has the potential to serve a wide range of medicinal roles, thus according to GC-MS analysis, which revealed the presence of these biomolecules. The presence of some of the important components resolved by GC-MS analysis and their biological activities were reported in this study. Consequently, this type of GC-MS analysis is a step toward comprehending the nature of the active principles in this

Table 4: Activity of Phyto-Components identified in the aqueous extracts of *Erythrina variegata* leaves.

Compound	Nature of compound	Property/Activity	Reference
17-Octadecynoic acid	Fatty acids	Antioxidant, Nematicide, Pesticide and lipid synthesis	Pauline *et al.* (2016)
Hexadecanoic acid, methyl ester	Fatty acid ester	Antioxidant, nematicide, pesticide , insectifuge, alpha reductase inhibitor, free radical scavenger, peroxidase substrate reductant and lipid peroxidase inhibitor	Ali *et al.* (2021)
Methyl 9-cis,11-trans-octadecadienoate	Fatty acid methyl ester	Antioxidant activity	Salisu *et al.* (2019)
11-Octadecenoic acid, methyl ester	Fatty acid methyl ester	Antioxidant and antimicrobial activity	Rahman *et al.* (2014)
Dasycarpidan-1-methanol, acetate (ester)	Ester	Anti-bacterial, antimicrobialactivity and antifungal activity	Saad *et al.* (2020)
9-Octadecenamide, (Z)-	Amide	Antimicrobial and antioxidant activity	Kim *et al.* (2020)
Oleic Acid	Fatty acid	Antitoxidant, insecticidal, larvicidal and antibacterial activity	Shaimaa *et al.* (2021)
9,12-Octadecadienoic acid (Z,Z)-, 2-hydroxy-1-(hydroxymethyl) ethylester	Fatty acid ethyl ester	Insectifuge, nematicide, 5-alpha reductase inhibitor, antioxidant, free radical scavenger peroxidase substrate, reductant and lipid peroxidase inhibitor	Ali *et al.* (2021)
9-Octadecenoic acid (Z)-, 2,3-dihydroxypropyl ester	Fatty acid ester	Insectifuge, antimicrobial, antioxidant, free radical scavenger, peroxidase substrate reductant, lipid peroxidase inhibitor, surfactant and emulsifying properties	Yomica *et al.* (2017)
9-Octadecenoic acid (Z)-, 2-hydroxy-1-(hydroxymethyl) ethyl ester	Fatty acid ethyl ester	Insectifuge, nematicide, 5-alpha reductase inhibitor, antioxidant, free radical scavenger peroxidase substrate, reductant and lipid peroxidase inhibitor	Sushma and Arun (2016)

Table 5: Activity of phyto-Components identified in the ethanol extracts of *Erythrina variegata* leaves.

Compound	Nature of compound	Property/Activity	Reference
1,2,3-Butanetriol	Alcohol	Antioxidant activity	Puntel *et al.* (2008)
Diethyl Phthalate	Plasticizer compound	Antioxidant, antibacterial, antifungal antimicrobial, insecticide, plastilizer, pesticide and insect repellent	Ameera *et al.* (2015);
6-Hydroxy-4,4,7a-trimethyl-5,6,7,7a-tetrahydrobenzofuran-2(4H)-one	-	Antioxidant and antimicrobial activity	Sumitra *et al.* (2016)
n-Hexadecanoic acid	Saturated fatty acid	Antioxidant, antibacterial, nematicide, hemolytic, pesticide, 5-alpha reductase inhibitor, free radical scavenger, peroxidase substrate reductant and lipid peroxidase inhibitor	Ali *et al.* (2021)
Eicosanoic acid	Fatty acid	Alpha-glucosidase inhibitors activity	Elaiyaraja and Chandramohan (2016)
9,12,15-Octadecatrienoic acid, (Z,Z,Z)-	Fatty acid	Antibacterial, nematicide, 5-Alpha reductase inhibitor, insectifuge, antioxidant, free radical scavenger peroxidase substrate, reductant and lipid peroxidase inhibitor	Ali *et al.* (2021)
9,12-Octadecadienoic acid (Z,Z)-, 2-hydroxy-1-(hydroxymethyl)ethyl ester	Polyunsaturated fatty acid	Nematicide, 5-Alpha reductase inhibitor, insectifuge, antioxidant, free radical scavenger, peroxidase substrate, reductant and lipid peroxidase inhibitor	Sushma *et al.* (2016)
9-Octadecenoic acid (Z)-, 2,3-dihydroxypropyl ester	Fatty acid ester	Insectifuge, antimicrobial, antioxidant, free radical scavenger, peroxidase substrate reductant, lipid peroxidase inhibitor, surfactant and emulsifyingproperties	Yomica *et al.* (2017)

Table 6: Activity ofphyto-components identified in the hexane extracts of *Erythrina variegata* leaves.

Compound	Nature of compound	Property/Activity	Reference
2-Pyrrolidinone, 1-methyl-	Cyclic amide	Antibacterial, antifungal and anticancer activity	Chouni *et al.* (2021)
Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester	Amino compound	Antimicrobial, antioxidant, hemolytic, pesticide, flavour, free radical scavenger	Ali *et al.* (2015)
n-Hexadecanoic acid	Saturated fatty acid	Antioxidant, antibacterial, nematicide, hemolytic, pesticide, 5-alpha reductase inhibitor, free radical scavenger, peroxidase substrate, reductant and lipid peroxidase inhibitor	Ali *et al.* (2021)
9,12-Octadecadienoic acid (Z,Z)-	Polyunsaturated fatty acid	Insecticidal activity, larvicidal activity, nematicide, insectifuge, 5-Alpha reductase inhibitor, antioxidant, free radical scavenger, peroxidase substrate, reductant and lipid peroxidase inhibitor	Ali *et al.* (2021)
9,12,15-Octadecatrienoic acid, (Z,Z,Z)-	-	Nematicide, 5-Alpha reductase inhibitor, insectifuge, antioxidant, free radical scavenger peroxidase substrate, reductant and lipid peroxidase inhibitor	Ali *et al.* (2021)
9,12-Octadecadienoic acid, ethyl ester	-	Nematicide, 5-Alpha reductase inhibitor, insectifuge, antioxidant, antibacterial, antimicrobial, free radical scavenger peroxidase substrate, reductant and lipid peroxidase inhibitor	Ali *et al.* (2021);
9,12-Octadecadienoic acid (Z,Z)-2-, hydroxy-1- (hydroxymethyl) ethylester	Polyunsaturated fatty acid	Nematicide, 5-Alpha reductase inhibitor, insectifuge, antioxidant, free radical scavenger peroxidase substrate, reductant and lipid peroxidase inhibitor	Sushma *et al.* (2016)
9-Octadecenoic acid (Z)-, 2,3-dihydroxypropyl ester	Fatty acid ester	Insectifuge, antimicrobial, antioxidant, free radical scavenger, peroxidase substrate reductant, lipid peroxidase inhibitor, surfactant and emulsifyingproperties	Yomica *et al.* (2017)
Tetratetracontane	-	Antioxidant and cytoprotective activities	Amuda *et al.* (2018)

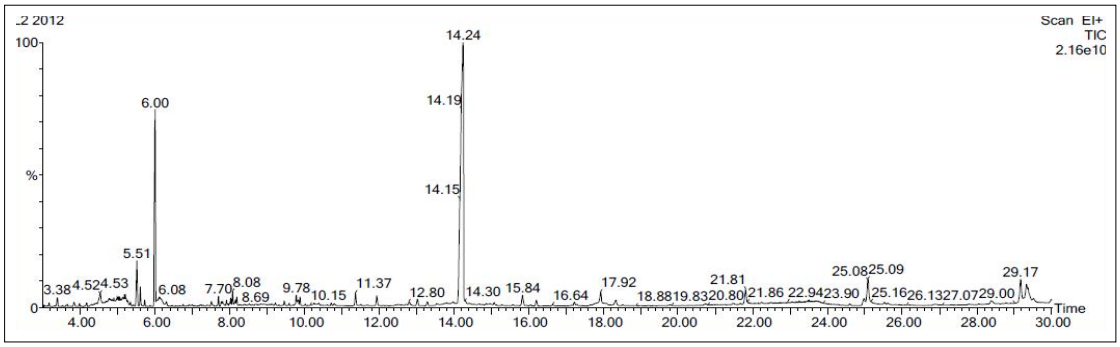

Fig 3: GC-MS chromatogram of hexane leaf extract of *Erythrina variegate*.

medicinal plant and this kind of study will be useful for more in-depth investigation.

CONCLUSION

The present phytochemical study of *Erythrina variegata* leaf extract was studied using three different solvent extracts revealed the presence of various bioactive components in leaf extracts *of Erythrina variegata*. By considering the above data, the ethanol leaf extract showed the potent more bioactive compounds with highest peak area percentage compared with aqueous and hexane extract. In which the GC-MS analysis of leaf extract exhibited a profiles and this may helpful for the development of several herbal formulations with antioxidant, insecticidal, antimicrobial and antifungal properties and it is used for various ailments by traditional practitioners. Therefore, more research on the bioactivity, toxicity profile, isolation and identification of specific constituents are very much needed. It is also time to explore its pharmacological values at the molecular level with the help of various biotechnological techniques in the future.

Conflict of interest: None.

REFERENCES

Afolayan, A.J. and Jimoh, F.O. (2008). Nutritional quality of some wild leafy vegetables in South Africa. International Research on Food Science and Nutrition. 60: 424-431.

Ali, A.S.M.R., Anwarul, M.H., Joy, S., Samima, N.M., Mahbubur, M.R., Abu, M.T., Zidan, K., Mamunur, R., Golam, S., Toshifumi, T. and Khurshid, A. (2021). Antiproliferative and antioxidant potentials of bioactive edible vegetable fraction of *Achyranthes ferruginea* Roxb. in cancer cellline. Food Science and Nutrition. 9: 3777-3805.

Ali, H.A., Imad, H.H. and Salah, A.I. (2015). Analysis of bioactive chemical components of two medicinal plants (*Coriandrum sativum* and *Melia azedarach*) leaves using gas chromatography -mass spectrometry (GC-MS). African Journal of Biotechnology. 14(40): 2812-2830.

Ameera, O.H., Imad, H.H., Huda, J. and Muhanned, A.K. (2015). Determination of alkaloid compounds of *Ricinus communis* by using gas chromatography-mass spectroscopy (GC-MS). Journal of Medicinal Plants Research. 9(10): 349-359.

Amudha, P., Jayalakshmi, M., Pushpabharathi, N. and Vanitha, V. (2018). Identification of bioactive components in *Enhalus acoroides* seagrass extract by Gas Chromatography-Mass Spectrometry. Asian Journal of Pharmaceutical and Clinical Research. 11(10): 313-317.

Baranitharan, M., Sawicka, B. and Gokulakrishnan, J. (2019). Phytochemical profiling and larval control of *Erythrina variegata* methanol fraction against malarial and filarial vector. Advances in Preventive Medicine. 2641959: 1-9.

Belkacem, N., Djaziri, R., Lahfa, F., El-Haci, I.A. and Boucherit. Z. (2013). Phytochemical screening and *in vitro* antioxidant activity isolated bioactive compounds from *Tridax procumbens* Linn. Pakistan Journal of Biological Sciences. 16(24): 1971-1977.

Cao, G., Sofic, E. and Prior, R.L. (2009). Antioxidant and pro-oxidant behaviour of flavonoids: Structure activity relationships. Free Radical Biology and Medicine. 22: 749-760.

Chouni, A., Amrita, P., Priya, K.G. and Santanu, P. (2021). GC-MS analysis and screening of anti-proliferative potential of methanolic extract of *Garcinia cowa* on different cancer cell lines. Pharmacognosy Journal. 13(2): 347-361.

Devi, R.M. and Manoharan, A. (2011). Characteristics of pharmacognostical significance of *Erythrina variegata* Var. and *Ficus racemosa* Linn. bark. Journal of Chemical and Pharmaceutical Research. 3: 707-714.

Elaiyaraja, A. and Chandramohan, G. (2016). Comparative phytochemical profile of *Indoneesiella echioides* (L.) Nees leaves using GC-MS. Journal of Pharmacognosy and Phytochemistry. 5(6): 158-171.

Hemmalakshmi, S., Priyanga, S. and Devaki, K. (2016). Phytochemical screening and HPTLC fingerprinting analysis of ethanolic extract of *Erythrina variegata* L. Flowers. International Journal of Pharmacy and Pharmaceutical science. 8: 210-217.

Hemmalakshmi, S., Priyangaa, S. and Devaki, K. (2017). Fourier Transform Infra-Red Spectroscopy Analysis of *Erythrina variegata* L. Journal of Pharmaceutical Sciences and Research. 9(11): 2062-2067.

Jagadish, K.S. and Berlin, V.M.G. (2017). Phytochemical profile and free radical nitric oxide (NO) scavenging activity of *Averrhoa bilimbi* L. fruit extract. 3 Biotech. 7(1): 85. doi: 10.1007/s13205-017-0678-9. Epub 2017 May 12.

Kim, B.R., Hyun, M.K., Chang, H.J., Si-Yong K., Kim, J.B., Yeo, G.J., Kong, Y.P., Lee, I.S. and Han, A.R. (2020). Composition and antioxidant activities of volatile organic compounds in radiation-bred coreopsis cultivars. Plants. 9: 717. https://doi.org/10.3390/plants9060717.

Kumar, A., Lingadurai, S., Shrivastava, T.P., Bhattacharya, S. and Haldar, P.K. (2011). Hypoglycemic activity of *Erythrina variegata* leaf in streptozotocin induced diabetic rats. Pharmaceutical Biology. 49(6): 577-582.

Mohanad, J.K., Abeer, F.A. and Imad, H.H. (2017). Determination of bioactive compounds of methanolic extract of *Vitis vinifera* using GC-MS. International Journal of Toxicological and Pharmacological Research. 9(2): 113-126.

Newman, D.J., Cragg, G.M. and Snadder, K.M. (2003). Natural products as sources of new drugs over the period 1981-2002. Journal of Natural Products. 66(7): 1022-1037.

Pauline, F.M.A. and Sagaya, G.R. (2016). Phytochemical screening and GC-MS analysis in ethanolic leaf extracts of *Ageratum conyzoides* (L.). World Journal of Pharmaceutical Research. 5(7): 1019-1029.

Preeti, K. and Chandrawati, K. (2017). Column chromatography fractional analysis of *Erythrina variegata* L. leaf extract for its antibacterial efficacy. International Journal of Advanced Research. 5(8): 279-285.

Puntel, G., de Carvalho, N., Gubert, P., Schwertner Palma, A., Dalla Corte, C., Avila, D., Pereira, M., Gervini, V., Bresolin, L. and Rocha, J.B. (2008). Butane-2, 3-dionethiosemicarbazone: An oxime with antioxidant properties. Chemico-biological Interactions. 177: 153-160.

Rahman, M.M., Ahmad, S.H., Mohamed, M.T.M., Ab Rahman, M.Z. (2014). Antimicrobial compounds from leaf extracts of *Jatropha curcas, Psidium guajava* and *Andrographis paniculata*. The Scientific World Journal. 1-8.

Saad, S.A., Hafiz, A.M., Santhosh, J.M. and Sivakumar, S.M. (2020). Documentation of bioactive principles of the flower from *Caralluma retrospiciens* (Ehrenb) and *in vitro* antibacterial activity - Part B. Arabian Journal of Chemistry. 13: 7370-7377.

Sakat, S.S. and Juvekar, A.R. (2010). Comparative study of *Erythrina indica* Lam. (Fabaceae) leaves extracts for antioxidant activity. Journal of Young Pharmacists. 2(1): 63-67.

Salisu, T.F., Okpuzor, J.E. and Jaja, S.I. (2019). Identification, characterization and quantification of chemical compounds in selected edible wild leafy vegetables. Ife Journal of Science. 21(1): 215-227.

Shaimaa, F., Eman, E.E., Sulaiman, A.A., Saleh, A., Gawhara, M.M. and Abu, E.H. (2021). Agro-waste derived compounds (flax and black seed peels): Toxicological effect against the West Nile virus vector, *Culex pipiens* L. with special reference to GC-MS analysis. Saudi Journal of Biological Sciences. 28(2): 1-7.

Sowmya, S., Chella Perumal, P., Anusooriya, P., Vidya, B., Pratibha, P. and Gopalakrishnan, V.K. (2015). *In vitro* antioxidant activity, *in vivo* skin irritation studies and HPTLC analysis of *Cayratia trifolia* (L.) Domin. International Journal of Toxicological and Pharmacological Research. 7: 1-9.

Sumitra, S. and Bhagwati, D. Estimation of Phytoconstituents from *Citrullus colocynthis* (L.) Schrad Roots Extract by GC-MS Spectroscopy. International Journal of Science and Research. 7(8): 648-652.

Suriyavathana, M., Subha, P., Senthilkumar, S., Sumathi, S., Kavitha, R.M. and Ramalingam, K. (2016). Phytochemical profile of erythrina variegata by using high-performance liquid chromatography and gas chromatography-mass spectroscopy analyses. Journal of Acupuncture and Meridian Studies. 9(4): 207-212.

Sushma, J. and Arun, K. (2016). Analysis of bioactive components from ethyl acetate and ethanol extract of *Mucuna pruriens linn* seeds by GC-MS technique. Journal of Chemical and Pharmaceutical Research. 8(8): 403-409.

Yomica, L., Powder, G. and Faisal, K.M. (2017). GC-MS analysis of the bioactive phytoconstituents of various organic crude extracts from the seed kernels of *Manilkara bidentata* (balata) collected in Trinidad, W.I. Natural Product Research. 32(3): 358-361.