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Research Article

Ethnoecological appraisal, mineral and phytochemical analysis of five species of Myrtaceae in University Campus, Peshawar, Pakistan

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Abstract

The current work was carried out to inspect the ecological features, ethnobotanical importance, elemental and phytochemical integrants of *Callistemon lanceolatus*, *Eucalyptus camaldulensis*, *Myrtus communis*, *Psidium guajava* and *Syzygium cumini* of Myrtaceae from district Peshawar. Ethnobotanical profile showed that (80%) plants were used in medicines, (60%) as fuel and (40%) as each lumber, fruits and decorative. Leaf size classification showed that Mesophylls were dominant (40%) while Microphyll, Nanophyll and Macrophyll were each (20%). Life form spectrum were dominated by Mesophanerophytes and Megaphanerophytes each (40%) and Nanophanerophytes (20%). (60%) species were at pre-reproductive while (40%) in reproductive stage. 13 elements (Carbon (C), Nitrogen (N), Oxygen (O), Magnesium (Mg), Potassium (K), Phosphorus (P), Sulphur (S), Calcium (Ca), Aluminum (Al), Silicon (Si), Iron (Fe), Chlorine (Cl) and Sodium (Na) were analyzed which were quantitatively different from taxa to taxa. Phytochemical constituents like anthraquinones, flavonoid, saponins, terpenoids, tannins, phlobatannins and steroids were screened out in the Ethanolic extract of leaves. The secondry metababolies were unequally dispersed among the five species. The current study is an attempt to assess mineral and phytochemical ingredients of five species of Myrtaceae collected from Peshawar, University campus.

Keywords: Ethnoecology; Ethnobotany; Minerals; Peshawar campus; Phytochemicals

Introduction

Plants are vital for human beings as they are the spring of energy, wood, powder, medicines and food **[1-4]**. In developing countries more than 80% Population depend on medicinal plants for their primary health care **[5]**. This is because of their limited availability to hospitals, basic health care facilities and high prices. Therapeutic plants and plants based natural medicines are widely used in developing countries in basic health care systems, and much appreciated in developed nations **[4]**. The investigation of medicinal plants through Quantitative elemental and phytochemical analysis has become significant from last few decades. These techniques are using universally for novel reports, authentication and find out the medicinal importance of the species. The phytochemical screening approach is measured as one of the effective

techniques in determining biologically active profile of medicinal taxa of therapeutic importance. Elemental screening by EDX is considered as one of the proficient and active technique to highlight the elemental profile of medicinal plants. Myrtle is a recognized for its giant trees, rich in volatile lubricates, tough leaves with greasy external surface and used in various prescriptions [6]. The family has an extensive humid and moderate distribution with more than 3800 taxon and about 138 genera. It comprises various economically important fruits plants and agricultural species [7]. *Psidium guajava* is an ever-green small tree with leaves hold anti-septic, anti-cough and anti-microbial properties [8]. The vital oil extracted from *Eucalyptus* was castoff as a medicine for cough, cold and as adenoidal drops [9]. World highest plant *Eucalyptus* species also belongs to family Myrtaceae. Herbal system of drugs documented the use of *Syzygium cumini* in liver stimulant, toughen teeth, stomach problems and a very virtuous cream against worm infections of the skull [6, 10]. *Callistemon* species are widely used in agriculture, forestry, essential lubricant production, degraded terrestrial retrieval and for decorative drives [11, 12]. *Myrtus communis* is used as blood cleanser, anti-hyperglycemic, antimicrobial and for numbing activities [13].

The elemental configuration of the species was find out through Energy Dispersive X-ray (EDX) Spectrometer. Secondary metabolites are active constituents present in all plant parts utilized in medications in primary health care. The objective of the present study is to examine ethno-botanical importance, elemental profile and phytochemical compoents of economically important species of Myrtaceae.

Materials and Methods

Study area and climate

Peshawar is the sixth biggest city of Pakistan situated in the middle of Province Khyber Pakhtunkhwa. Its topographical position is 33° 44/ and 34° 15/ north latitudes and 71° 22/ and 71° 42/ east longitudes. It is confined by District Mohmand and Khyber districts on the west, Nowshera on the east, Kohat on the south and District Charsadda on the north (Fig. 1). Edaphology associated with the outcome of soil on active organisms mostly plants. The vegetation cover of Peshawar has a great diversity due to joint deposits of silt, sand and clay soil. Climatically the area has extreme weather condition with very hot summer (40.8℃) and mild winter (18.35℃). The extreme rain precipitation occurs in the month of September having (114mm) and lowest (50.0mm) in June.

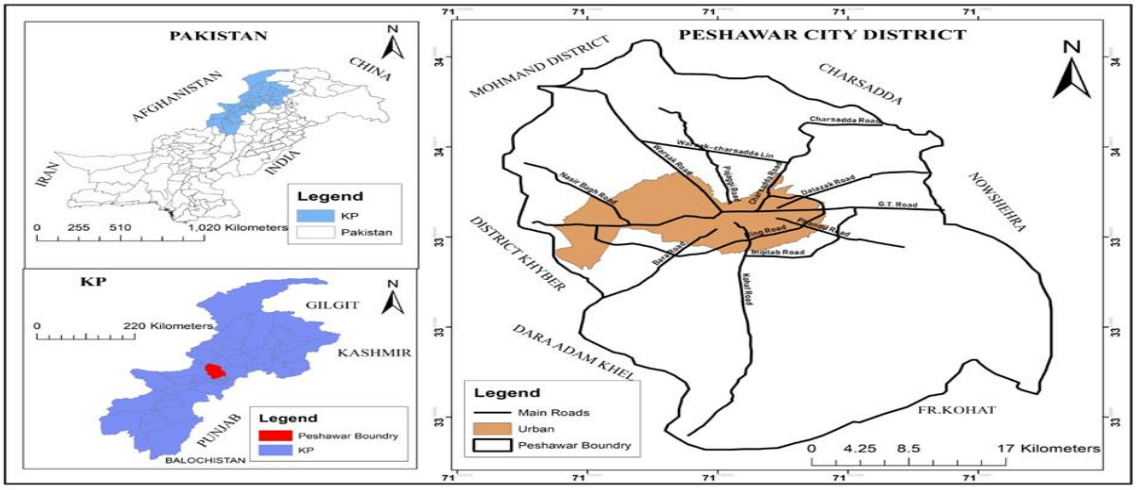

Figure 1. Map of study area: Source; GIS Department, UOP

Collection of plant leaves

Fresh leaves of five species of Myrtaceae, *Callistemon lanceolatus, Eucalyptus camaldulensis, Myrtus communis, Psidium guajava* and *Syzygium cumini* were collected from Peshawar University campus (Fig. 2). The plant specimens were identified by taxonomists in the herbarium of Department of Botany, University of Peshawar. The leaves were washed, shade dried for fifteen days, crushed into powder through electrical grinder and kept in polythene bags with appropriate labeling.

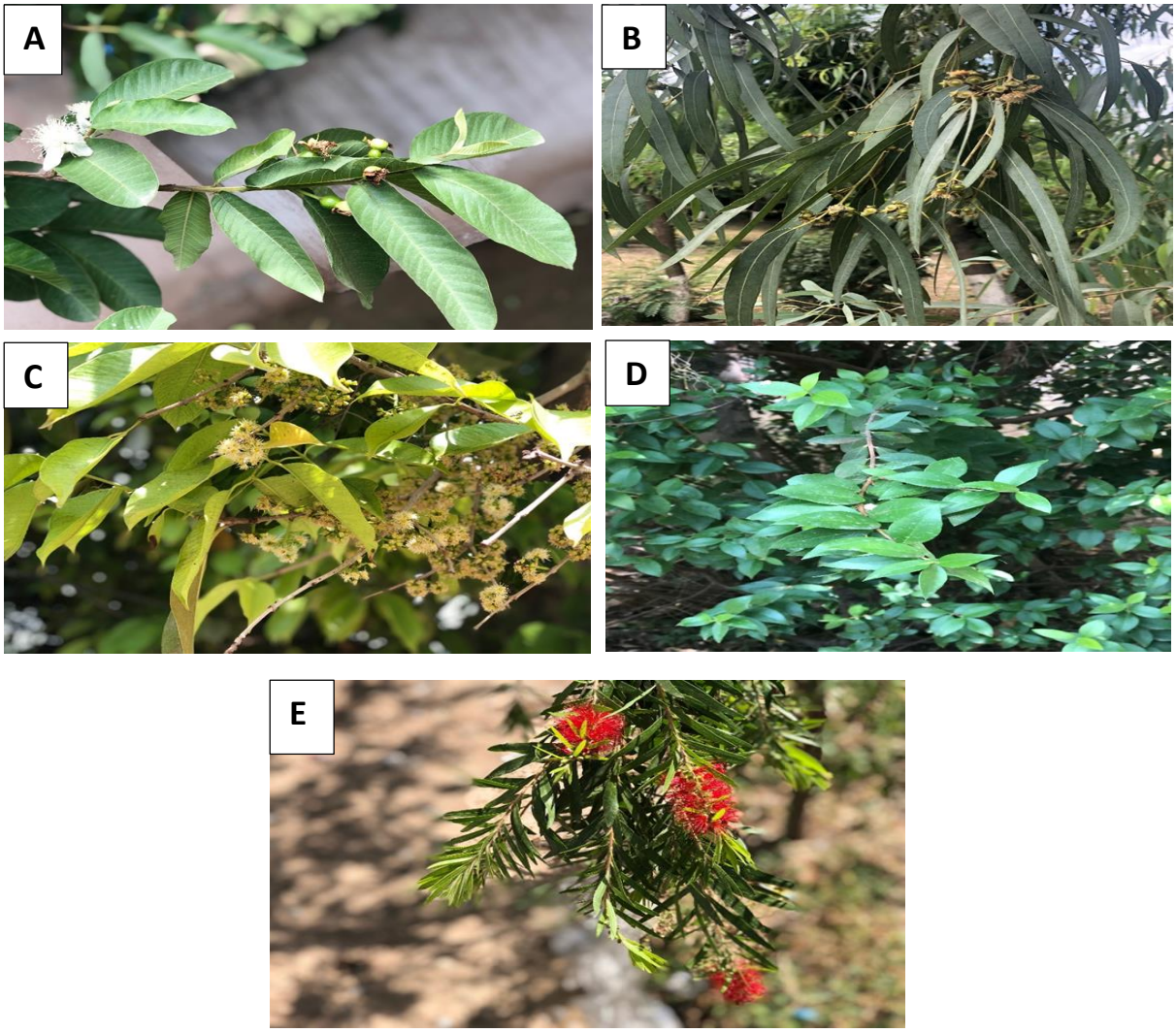

Figure 2. Keys: **A.** *Psidium guajava;* **B.** *Eucalyptus camaldulensis;* **C.** *Syzygium cumini;* **D.** *Myrtus communis;* **E.** *Callistemon lanceolatus*

Ethnobotanical and ethnomedicinal profile

Ethnobotanical topographies of plants vary from habitat to habitat. Biological spectra like leaf size, life form, leaf shape and phenology were observed following [12-14]. Ethnobotanical studies play an important role in emphasizing significance of plant species in an area. Ethnobotanical and ethnomedicinal uses of the plants were composed through semi structured questionnaire from old aged people and local herbalists. The species were investigated for ethnobotanical uses such as fruit, timber, fuel and medicines.

Phytochemical assesement

Preparation of extract

60 grams of each plant powder were added in a conical flask containing 270 ml. of ethanol. By using Whatman No. 1 filter

paper the extract was filtered after three days. After filtration, the extract was kept in air tight flask at 4℃ for further studies.

Flavonoids

0.5 gram of plant powder was added to 5 ml. of dilute ammonia solution and then concentrated H_2SO_4 was added. The signal of yellow color showed the presence of flavonoid which vanished later on standing [15].

Steroids

1 ml. plant extract was added to 10 ml. of chloroform followed by the addition of concentrated H_2SO_4 on the side of the test tube. The arrival of red color in the upper portion and yellow with green florescence in Sulphuric acid (H_2SO_4) layer indicated the occurrence of steroids [16].

Tannins

0.5 gram of plant powder was shaken with 100 ml. of distilled water and filtered. Then 0.1% ferric chloride reagent was added to 20ml.of filtrate. The creation of blue green coloration specified the presence of tannins [17].

Saponin

0.5 gram of each plant powder was stirred with 5 ml. of distilled water. The realization of foaming bubbles on warming indicated the presence of saponin [18].

Terpenoids

0.5 gram of plant sample was shaken with 2 ml. of chloroform followed by the careful addition of concentrated H_2SO_4 to form a coating. A reddish-brown coloration was taken as preliminary evidence for the presence of terpenoids [19].

Phlobatannins

0.2 gram of each plant powder was bubbled in 1% aqueous HCl, the appearance of red precipitate complete the presence of phlobatannins [19, 15].

Anthraquinones

5 ml. of chloroform was stirred with 0.5 gram of extract, filtered and added 10% ammonia solution to the filtrate. After shaking thoroughly the appearance of yellow or red color in the ammonical phase stated the presence of anthraquinones [19].

Minerals assessment

Energy Dispersive X-ray (EDX) Spectrometer (Model Perkin Elmer 700) was used to determine the macro and micro minerals in the Centralized Resource Laboratory, University of Peshawar, Peshawar.

Results and Discussion

Ethnobotanical and ethnomedicinal profile

The current research work was carried out to investigate the biological spectra (leaf size, leaf shape, life form and phenology), ethnobotanical applications, phytochemical assessment and elemental profile of five species of Myrtaceae. Biological spectrum of leaf size classes were dominated by Mesophyll (40%) followed by Microphyll, Nanophyll and Macrophyll each 20% with simple leaf shape (Fig. 3). Life form spectra represented that Mesophanerophyte and Megaphanerophyte were the major classes each with (40%) and Nanophanerophyte (20%) (Table 1; Fig. 4). Phenological behavior showed that during collection time most plants were in pre reproductive stage (60%), while (40%) plants were at reproductive stage (Table 2; Fig. 5). Ethnobotanical (80%) species were used in medicines, (60%) as fuel followed by 40% each fruit, timber and ornamental (Table 3). Ethnomedicinal profile showed that the plants contained secondary metabolites tannins and oleanolic acid which is used as anti-malarial, anti-diabetic and anti-microbial (Table 4). Ethnomedicinal importance of the plants was also reported by [20-22].

Elemental profile

The plant species were quantitively investigated for 13 vital elements (Table 5; Fig. 6). A total of eight elements were found in all species among which six were macro elements (C, O, Mg, K, S and Ca) and two were minor (Al and Si). The maximum Carbon content was observed in *Callistemon lanceolatus* (67.18%) and

minimum was found in *Eucalyptus camaldulensis* (60.58%). In macro elements Nitrogen and Phosphorous were absent in *Myrtus communis*. The maximum amount of Iron was found in *Eucalyptus camaldulensis* (0.43%) followed by *Myrtus communis* (0.27%) and *Psidium guajava* (0.20%). Chlorine was present in *Callistemon lanceolatus* and *Syzygium cumini* while Na was only present in *Callistemon lanceolatus*. The macro and micronutrients are essential for the proper functioning of body and different enzymatic activities [23, 24]. The results agreed with [25, 26] which reported the same elements from *Syzygium cumini* and *Psidium guajava*.

Phytochemical assessment

The qualitative phytochemical screening of methanolic extracts showed the presence of terpenoid, flavonoids, steroids, tannins, saponins, phlobatannins and anthraquinones (Table 6). Flavonoids, saponins and anthraquinones were present in all species while phlobatannins were present only in *Callistemon lanceolatus* and *Eucalyptus camaldulensis*. The leaves extract of *Syzygium cumini* revealed the presence of saponins, flavonoids and tannins, which are used to treat constipation, diabetes and to stop blood discharge in the feces [8]. Flavonoids, saponins and anthraquinones were present in all plants extract which are used as anti-cancer, antimalarial, anti-inflammatory and antioxidant [27]. The present study also supported the findings of [28, 22] which also reported the similar phytochemical in leaves of these plants.

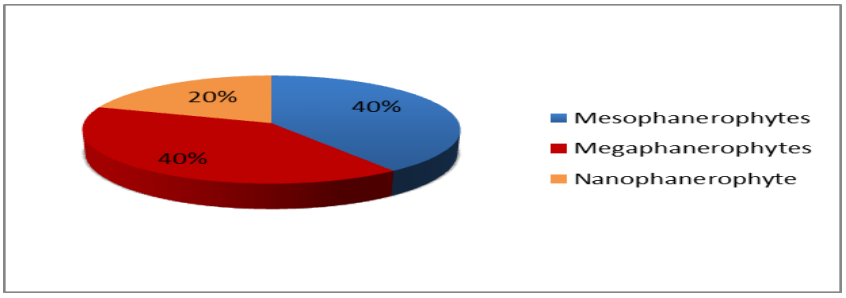

Figure 3. Life form classes

Table 1. Summary of Biological spectra of Myrtaceae Plant species in Peshawar, Pakistan

A. Life form

S. No.	Life form classes	No. of species	Percentage (%)
i.	Mesophanerophytes	2	40
ii.	Megaphanerophytes	2	40
iii.	Nanophanerophyte	1	20
Total		**5**	**100**

B. Leaf sizes

S. No.	Leaf sizes classes	No. of species	Percentage (%)
i.	Mesophyll	2	40
ii.	Microphyll	1	20
iii.	Nanophyll	1	20
iv.	Macrophyll	1	20
Total		**5**	**100**

C. Leaf shape

S. No.	Leaf shape classes	No. of species	Percentage (%)
i.	Simple	5	100

Total	5	100

D. Phenology

S. No.	Phenological stages	No. of species	Percentage (%)
i.	Pre reproductive (S1)	3	60
ii.	Reproductive (S2)	2	40
Total		**5**	**100**

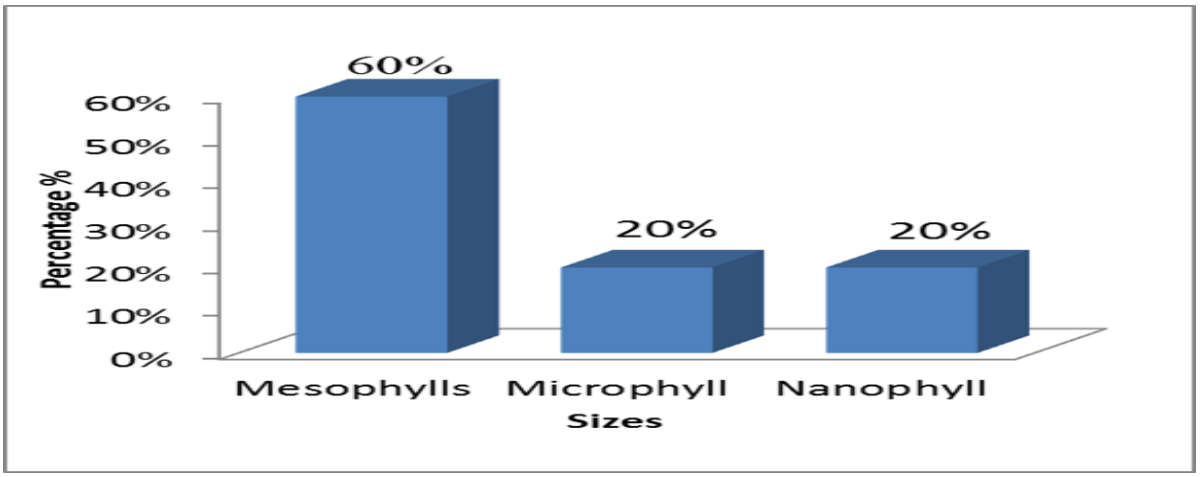

Figure 4. Leaf size classes

Table 2. Biological spectra of Myrtaceae Plant Species in Peshawar, Pakistan

S. No.	Plant Species	Life form	Leaf size	Leaf shape	Phenology
A.	**Angiosperms**				
a.	**Dicots**				
1.	**Family Myrtaceae**				
1.	*Callistemon lanceolatus* (Sm.) Sweet.	MesP	Mic	S	S2
2.	*Eucalyptus camaldulensis* Dehnh.	MegP	Mes	S	S1
3.	*Myrtus communis* L.	NP	N	S	S1
4.	*Psidium guajava* L.	MesP	Mac	S	S1
5.	*Syzygium cumini* (L.) Skeels.	MegP	Mes	S	S2

Keys: Mes P. Mesophanerophyte Np. Nanophanerophytes MegP. Megaphanerophytes Mic. Microphyll Mac. Macrophyll N. Nanophyll Mes. Mesophyll S. Simple S1. Pre-reproductive S2. Reproductive

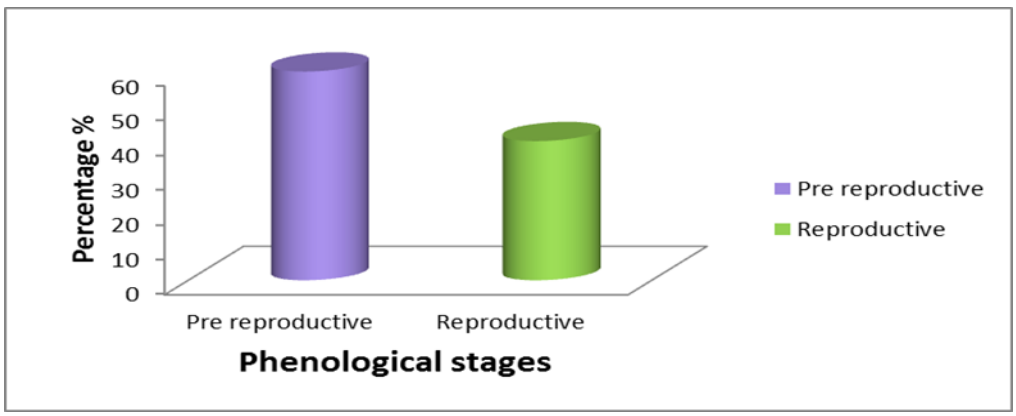

Figure 5. Phenological stages

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Table 3. Ethnobotanical profile of Myrtaceae Plant Speciesin Peshawar, Pakistan

S. No.	Plant Species	1.	2.	3.	4.	5.
1.	*Callistemon lanceolatus* (Sm.) Sweet	-	-	+	-	+
2.	*Eucalyptus camaldulensis* Dehnh.	-	+	+	-	-
3.	*Myrtus communis* L.	+	+	-	+	-
4.	*Psidium guajava* L.	+	+	-	+	-
5.	*Syzygium cumini* (L.) Skeels.	-	+	-	+	+
	Total	**2**	**4**	**2**	**3**	**2**
	%	**40**	**80**	**40**	**60**	**40**

Keys: 1. Fruit 2. Fuel 3. Medicinal 4. Ornamental 5. Timber

Table 4. Ethnomedicinal uses of Myrtaceae Plant Species in Peshawar, Pakistan

S. No.	Plant Species	Part used				Constituents	Diseases
		Root	Stem	Leave	Flower		
1.	*Callistemon lanceolatus* (Sm.) Sweet.	-	+	+	+	Callislignan A and B.	Anti-fungal, antioxidant and anti-diabetic.
2.	*Eucalyptus camaldulensis* Dehnh.	-	+	+	-	Cineol, Tannin, Kinotannic acid.	Anti-malarial, Anti-microbial and anti-septic
3.	*Myrtus communis* L.	-	-	+	-	Linalool and Myrtucommulone A and B.	Anti-microbial, anti-cancer and anti-diabetic.
4.	*Psidium guajava* L.	+	+	+	-	Oleanolic acid, Tannin, limonene and caryophyllele.	Skin aging, anti-microbial, anti-cough and anti-bacterial.

5.	*Syzygium cumini* (L.) Skeels.	+	+	+	+	Jambolan, anti-mellin and flavonoids.	Bronchitis, Asthma, anti-diabetic and diuretic.

Table 5. Mineral contents in Myrtaceae Plant Species of Peshawar, Pakistan

S. No.	Plant Species	Minerals %												
		Major Elements								Minor Elements				
		C	N	O	Mg	K	P	S	Ca	Al	Si	Fe	Cl	Na
1.	*Callistemon lanceolatus* (Sm.) Sweet	67.18	7.78	34.10	0.17	0.75	-	0.19	1.00	0.19	0.39	-	0.38	0.15
2.	*Eucalyptus camaldulens is* Dehnh.	60.58	5.12	36.90	0.28	1.24	0.34	0.14	2.47	0.18	0.31	0.43	-	-
3.	*Myrtus communis* L.	65.50	-	34.26	0.27	0.80	-	0.15	1.02	0.20	0.31	0.27	-	-
4.	*Psidium guajava* L.	61.99	6.85	36.04	0.35	1.24	0.18	0.32	1.99	0.23	0.65	0.20	-	-
5.	*Syzygium cumini* (L.) Skeels.	60.62	6.99	36.66	0.69	0.99	0.19	0.23	1.72	0.12	0.41	-	0.31	-

Figure 6. Different steps of elemental analysis

Table 6. Phytochemical screening of Myrtaceae plant Species in Peshawar, Pakistan

S. No.	Plants species	Flavonoids	Steroids	Tannins	Terpenoids	Saponins	Phlobatanins	Anthraquinones
1.	*Callistemon lanceolatus* (Sm.) Sweet	+	+	+	+	+	+	+
2.	*Eucalyptus camaldulensis* Dehnh.	+	+	+	+	+	+	+
3.	*Myrtus communis* L.	+	-	-	+	+	-	+
4.	*Psidium guajava* L.	+	-	-	-	+	-	+
5.	*Syzygium cumini* (L.) Skeels.	+	+	+	-	+	-	+

Conclusion

Phytochemical assessment and elemental analysis of five species of Myrtaceae was carried out for the first time for the species collected from Peshawar University campus. The current study concluded that five species of family Myrtaceae contains 13 different minor and major elements. From the above information's it is clear that phytochemicals of these species are of great importance and used for curing of different disease. And all the medicinal properties of these plants are due to above mentioned phytochemicals.

Authors' contributions

Conceived and designed the experiments: L Khattak & G Rukh, Performed the experiments: S Khan & S Shah, Analyzed the data: S Khan & SM Shah, Contributed materials/ analysis/ tools: S Khan, L Khattak & G Rukh, Wrote the paper: S Khan & S Shah.

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