

BOTANICAL AND PHYTOCHEMICAL STUDIES, NUTRITIONAL VALUE AND ANTIMICROBIAL PROPERTIES OF LEAVES OF *OPERCULINA TURPETHUM* (L.) SILVA. IN DAGON UNIVERSITY

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Abstract

Operculina turpethum (L.) Silva. (Kyar-hin) belongs to the family Convolvulaceae. In this research work, the specimens were collected from Dagon University Campus, East Dagon Township, Yangon Region, during the flowering and fruiting periods from February to July, 2023. In this paper, the morphological characters of plant and microscopical characters of leaves were studied at the Department of Botany, Dagon University by using available literatures. In morphological study, the plant was veins, stem with 3-5 wings; leaves were ovate, pubescent; flower white; sepal persistent, carpel-2, axile placentation. The microscopical characters of leaves were conducted by free hand section method. In microscopical study paracytic type of stomata was found in both surface and non-glandular trichomes were present. The preliminary phytochemical test of powdered leaves was examined in Dagon University. Alkaloid, carbohydrate, glycoside, phenolic compound, reducing sugar, flavonoid, saponin and tannin were present. The nutritional value was examined by David Pearson and Kjeldaha method and antioxidant activity was also examined by DPPH Assay Method at the Small Scale Industry Departments in North Okkalapa Township. This powder was found to contain carbohydrates, fiber, fat, proteins, ash and moisture, and energy value 320.73 kcal. Elemental analysis of the powder was found the elements, such as Ca, K, Fe, Cu and Sr. The antimicrobial activities of three extracts of sample showed against on *Agrobacterium* spp., among them Butanol extract is most affected to the test organisms.

Keywords: *Operculina turpethum* (L.) Silva, morphological, anatomical, phytochemical, nutritional value, antioxidant activity, EDXRF and antimicrobial activity

Introduction

The plant kingdom represents an enormous storage of biologically active compounds with various chemical structures and disease preventive properties. Discovery of novel drugs depending on the pharmacological as well as pathological properties, the critical information regarding the chemical constituents is generally provided by the qualitative phytochemical screening of plant extracts (Karmakar, 2021).

Medicinal plants may provide three main kinds of benefit: health benefits to the people who consume them as medicines; financial benefits to people who harvest, process, and distribute them for sale; and society-wide benefits, such as job opportunities, taxation income, and a healthier labour force (Mahady, 2001).

Operculina turpethum (L.) Silva. has several medicinal purposes. Root bark and seed of this plant are used in the treatment of skin disorders such as cervical lymphadenitis, fistulas, constipation, chronic gout, fever, bronchitis, ulcers, hemorrhoids, tumors, obesity, jaundice herpes, and induced lachrimation. The use of root powder for the treatment of rheumatism, flatulence, paralysis, scorpion sting, and snake bite was also proven (Kirtikar and Basu, 1987). Leaves are reported to possess antibacterial activities and there are reports about the use of fresh juice of leaves for the treatment of corneal opacity and conjunctivitis (Sharma, 2012).

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The aim of the research is to know the pharmacological uses of *Operculina turpethum* (L.) Silva. of leaves, to verify and confirm the morphological characters of vegetative and reproductive parts, to examine the microscopical characters of leaves, to investigate some activities of this plant phytochemical studies, nutritional value, antioxidant activity, EDXRF and antimicrobial activity.

Materials and Methods

Collection and preparation of specimens

The specimens of *Operculina turpethum* (L.) Silva. were collected from Dagon University Campus, East Dagon Township, Yangon Region, during the flowering and fruiting periods from February to June 2023.

After collection, the samples of *Operculina turpethum* (L.) Silva. Plants were thoroughly washed with water and dried at room temperature about three weeks. When constant weight of the sample was obtained, the dry samples were pulverized by grinding machine into fine powder and kept in air tight bottle to study the phytochemical, nutritional value, antioxidant, EDXRF and antimicrobial activities.

Morphological identification

For morphological studies, *Operculina turpethum* (L.) Silva. Plants of all the vegetative and reproductive parts of the fresh specimens were used. These specimens were identified by using the available literatures. Myanmar name was confirmed by Hundley and Chit Ko Ko (1987) and Kress *et al.* (2002).

Microscopical studies

For microscopical studies, the samples of *Operculina turpethum* (L.) Silva. were thoroughly washed with water. The petiole, lamina, and midrib were cut by free hand section and to examine under electron microscope (Bio Blue Lab.) at the Department of Botany, Dagon University. For microscopical studies, the fresh specimens were studied according to the methods of Metcalfe and Chalk (1979), Esau (2006), Pandey (2008) and Tandon Neeraj (2011).

Phytochemical Studies of powdered leaves of *Operculina turpethum* (L.) Silva.

The preliminary phytochemical studies on the powder leaves of *Operculina turpethum* (L.) Silva. had been undertaken. The experiment was carried out to determine the presence or absence of chemical compounds, according to the method of Marini Bettalo *et al.*, (1981) and Central Council of Research in Unani Medicine (1987) at Department of Botany, Dagon University.

Nutritional values

The nutrient contents in powdered leaves of *Operculina turpethum* (L.) Silva. were analyzed by using David Pearson (1976) and protein Kjeldahl (1883) method at the Small Scale Industries Department, Ministry of Agriculture, Livestock and Irrigation, North Okkalapa Township, Yangon Region.

Antioxidant activity

Antioxidant activity of leaves of *Operculina turpethum* (L.) Silva. by DPPH Assay Method at the Small Scale Industries Department, Ministry of Agriculture, Livestock and Irrigation, North Okkalapa Township, Yangon Region.

Elemental Analysis (EDXRF)

Elemental Composition of powder leaves of *Operculina turpethum* (L.) Silva was carried by EDX-720 at University Research Centre (URC) in Yangon University.

Antimicrobial Activities

Antimicrobial Activity test of *Operculina turpethum* (L.) Silva. leaves were carried out in the Department of Botany, Dagon University. The study of antimicrobial activity was performed by paper-disc diffusion methods according to the method of Atlas (1993) by using eight test organisms. These test organisms were provided by Department of Botany, Dagon University.

Results

Morphological Characters of *Operculina turpethum* (L.) Silva

Family	-	Convolvulaceae
Scientific name	-	<i>Operculina turpethum</i> (L.) Silva
English name	-	Indian jalap
Myanmar name	-	Kya-hin
Part used	-	Leaves

Veins, stems hollow, reddish-green, 3-5 winged; latex present. Leaves alternate, simple, petiole cylindrical, puberulent; the lamina broadly ovate, the base truncate, the margins entire, the tips mucronate to acute, pubescent on both surfaces; exstipulate. Inflorescences axillary cymes, 1-2 flowered. Flower white, bracteate, bract oblong, concave, pubescent; ebracteolate; pedicellate, puberulent; complete, bisexual, actinomorphic, pentamerous, hypogynous. Sepals 2+3, 2 outer sepals ovate, inner 3 sepals, elliptic, persistent. Petals (5), broadly ovate, funnel-shaped, twisted, puberulent. Stamens 5, epipetalous; the filament white, equal, hairs at the base; the anther dithecal, basifixed. Carpel (2), ovary superior, false septum present, axile placentation; the style slender; stigma bilobed, capitate; annular disc present. Fruit capsule, enclosed with enlarged sepals, persistent depressed, globose, pubescent; the seeds white in young, black-brown in mature (Figure 1).

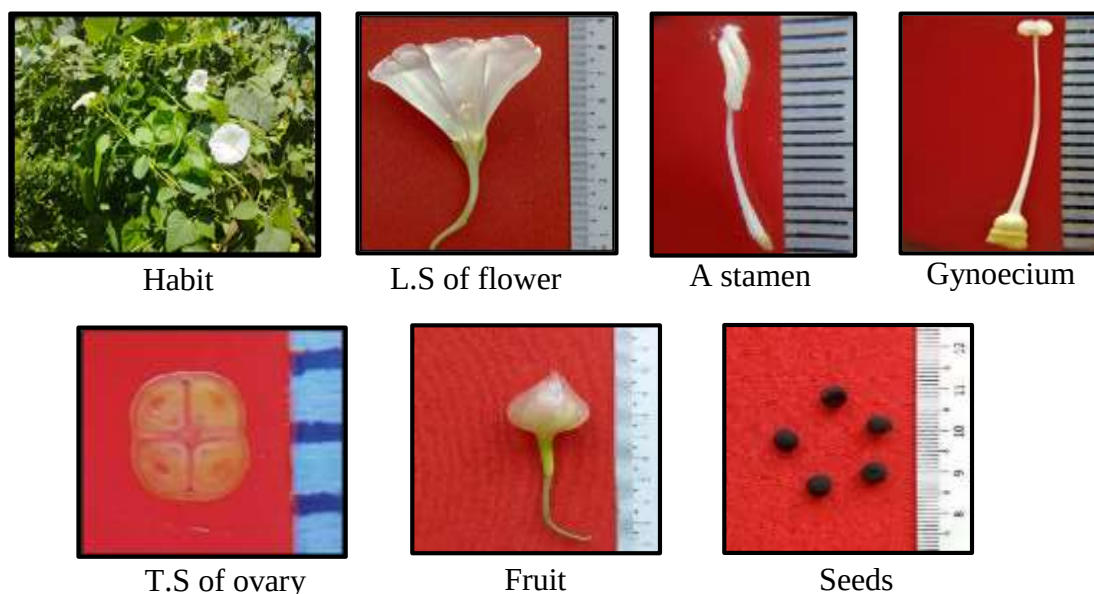


Figure 1. Morphological Study of *Operculina turpethum* (L.) Silva.

Microscopical Characters of leaves of *Operculina turpethum* (L.) Silva

Microscopical Characters of Leaves of *Operculina turpethum* (L.) was shown in Figure 2.

Lamina

In surface view, the upper and lower epidermal cells were parenchymatous, barrel shaped, thin-walled and completely arranged. Stomata were abundantly present on lower surface than upper. On both surfaces view of lamina found paracytic types of stomata. Non-glandular trichomes were present on both surfaces.

In transverse section, the cuticle layer was thin present on both surfaces. Epidermal cells were made up of one layer parenchymatous cells and oval to barrel shaped. The mesophyll layer composed of palisade and spongy parenchyma. Palisade parenchyma cells are found on upper side and two-layered. The spongy mesophyll consisted of 2-3 layers of cells and loosely arranged. The vascular bundles of lateral vein were embedded in mesophyll cells and oval in shape. They were bicollateral and open type.

The midrib

In transverse section of midrib, both surfaces were covered with thin cuticle. Uniseriate and multiseriate non glandular trichomes were present. The epidermal cells were only one layered, oval to barrel shaped and compactly arranged. The lower epidermal cells were similar to these the upper cells. Below the epidermis the cortex was differentiated into collenchyma. The collenchymatous cells below the epidermis consisted of 3-5 layers on the upper surface and 2-4 layers on the lower surface and oval or angular shape. The parenchymatous tissue composed of 5-8 layers in thickness below the vascular bundle and polygonal or rounded shapes. A few containing calcium oxalate crystals. The vascular bundles were oval in outline and embedded in the cortex. The vascular bundles were bicollateral and opened type.

Petiole

In transverse section, the petiole was basically semi-circular in outline and slightly concave in the upper side. The cuticle layer was thin. Non-glandular trichomes were present. The cortex was made up of two different types of tissues, outer collenchyma and inner parenchymatous tissues. The outer collenchymatous cells below the epidermis consisted of 3-5 layers in thickness on both surfaces. Vascular bundles embedded in ground tissue, arc shaped in outline. Vascular bundle was bicollateral and opened type and crescent shaped in outline. The phloem cells were consisted sieved tube elements and companion cells. Xylem cells were composed of vessel, tracheids, xylem fibers and xylem parenchyma.



Surface view of upper epidermis



Surface view of lower epidermis



T.S of lamina

Figure 2.a Microscopical Characters of Leaves of *Operculina turpethum* (L.) Silva.

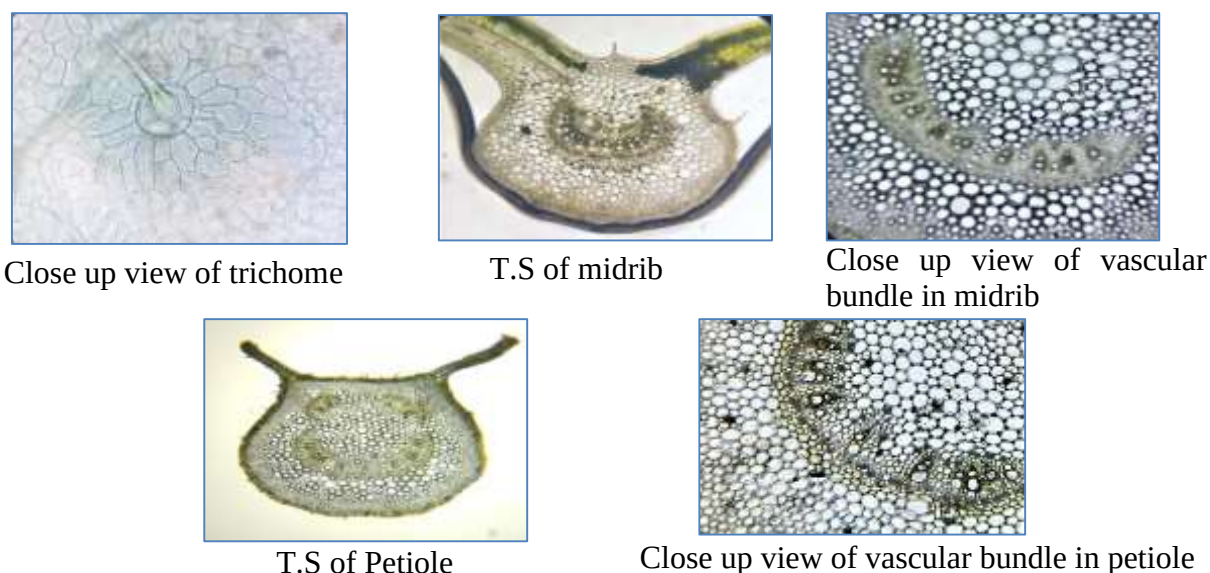


Figure 2.b Microscopical Characters of Leaves of *Operculina turpethum* (L.) Silva.

Chemical Studies

Preliminary phytochemical tests of *Operculina turpethum* (L.) Silva.

The preliminary phytochemical tests of the leaves of *Operculina turpethum* (L.) Silva. indicated the presence of alkaloid, carbohydrates, glycosides, phenolic compounds, reducing sugar, flavonoid, saponins and tannin show in Table 1, Figure 3 and 4.

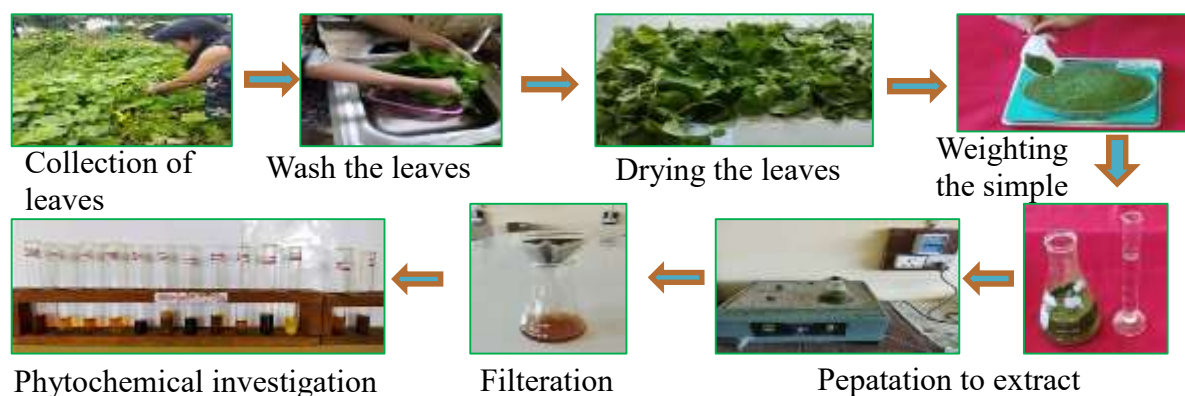


Figure. 3 Preliminary phytochemical tests of *Operculina turpethum* (L.) Silva.

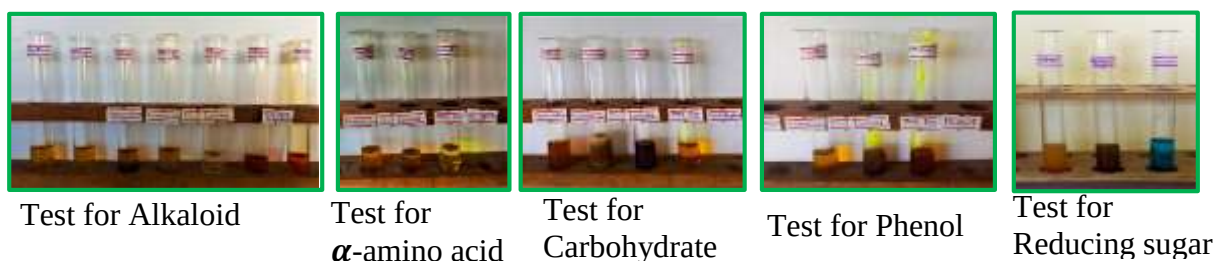


Figure 4.a Result of preliminary phytochemical tests of *Operculina turpethum* (L.) Silva.

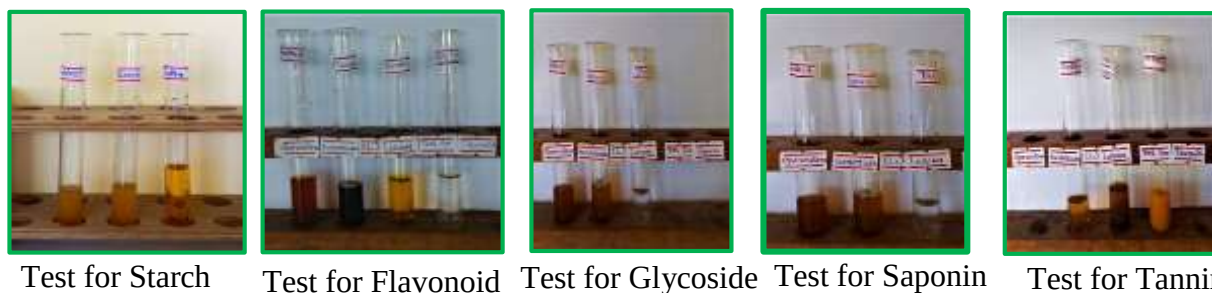


Figure 4.b Result of preliminary phytochemical tests of *Operculina turpethum* (L.) Silva.

Table 1. Preliminary phytochemical test of powdered leaves of *Operculina turpethum* (L.) Silva.

No.	Test	Extract	Test reagents	Observation	Result
1.	Alkaloid	DW	1.Mayer's reagent 2.Dragendroff's reagent 3.Wagner's reagent	No ppt. Orange ppt. Brown ppt.	- + +
2.	α -amino acid	DW	Ninhydrin reagent	No ppt.	-
3.	Carbohydrate	DW	10% α -naphthol+ Conc:H ₂ SO ₄	Creamy color	+
4.	Phenolic compound	DW	10% FeCl ₃ solution	Light brown ppt.	+
5.	Reducing sugar	DW	Benedict's solution	Brick red ppt.	+
6.	Starch	DW	Iodine Solution	Blue Brown	-
7.	Flavonoid	DW	Conc: HCl, Mg burning 10% lead acetate	Deep brown	+
8.	Glycoside	DW	10% lead acetate	White ppt.	+
9.	Saponin	DW	Distilled water	Frothing	+
10.	Tannin	DW	1%FeCl ₃	Yellowish brown ppt.	+

(+) = present (-) = absent ppt. = precipitation DW= distilled water

Nutritional values

According the result, protein, moisture, ash, fat, fiber and carbohydrate, and energy value 320.73 kcal found in leaves of *Operculina turpethum* (L.) Silva. The results were shown in Table 2.

Table 2. Determination of nutritional values from Powdered leaves of *Operculina turpethum* (L.) Silva

No.	Experiment	Percentage(%)
1	Moisture (%)	10.03
2	Ash (%)	6.89
3	Proteins (%)	13.33
4	Fat (%)	3.41
5	Fiber (%)	7.16
6	Carbohydrate (%)	59.18

Antioxidants activity

Antioxidant activity of leaves of *Operculina turpethum* (L.) Silva. by DPPH Assay Method. In this study, ascorbic acid was used as a standard, and different concentrations of extracts were used. According to the result ethanol extract of *Operculina turpethum* (L.) Silva was lowest IC₅₀ value than watery extract in Table 3.

Table 3. Determination of antioxidant activity from Powdered leaves of *Operculina turpethum* (L.) Silva

Extract	% Inhibition (mean $\pm$ SD) In Different Concentration (μ g /ml)						IC ₅₀
	50	100	200	400	600	800	
Water	32.72 $\pm$ 0.08	35.65 $\pm$ 0.08	50.24 $\pm$ 0.06	82.29 $\pm$ 0.04	93.89 $\pm$ 0.04	94.13 $\pm$ 0.04	198.34 $\pm$ 0.02
	25	50	100	200	400	600	
Ethanol	9.94 $\pm$ 0.16	20.35 $\pm$ 0.14	40.14 $\pm$ 0.10	53.55 $\pm$ 0.08	93.26 $\pm$ 0.07	94.82 $\pm$ 0.12	173.48 $\pm$ 0.04
	0.39	0.78	1.561	3.125	6.25	12.5	
Ascorbic	25.49 $\pm$ 3.6	38.07 $\pm$ 2.45	63.91 $\pm$ 0.06	86.33 $\pm$ 1.16	91.63 $\pm$ 0.33	90.17 $\pm$ 0.5	1.14 $\pm$ 1.39

Elemental Composition

Elemental Composition of powder leaves of *Operculina turpethum* (L.) Silva was carried by EDX-720 at University Research Centre (URC) in Yangon University. In this study the powdered leaves of *Operculina turpethum* (L.) Silva contain Calcium (Ca), Potassium (K), Iron (Fe), Copper (Cu) and Strontium (Sr), among them Ca is the highest content shown in Table 4.

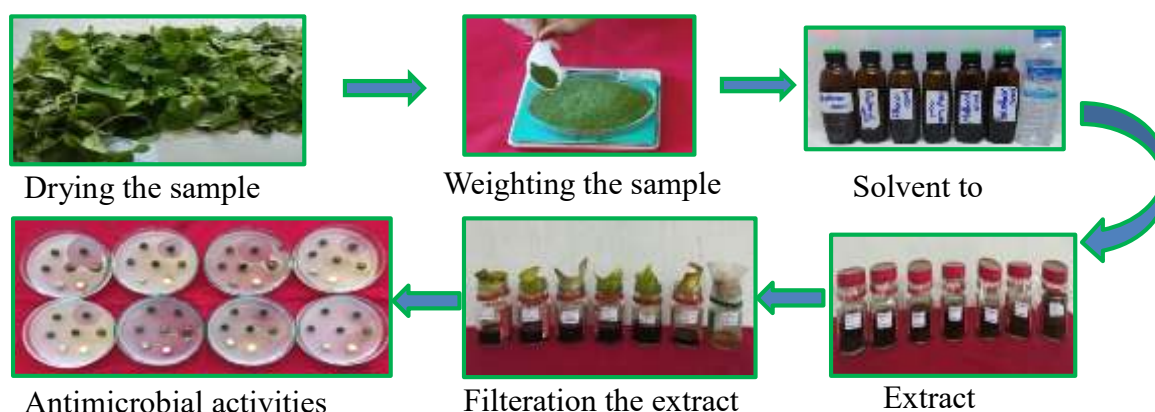
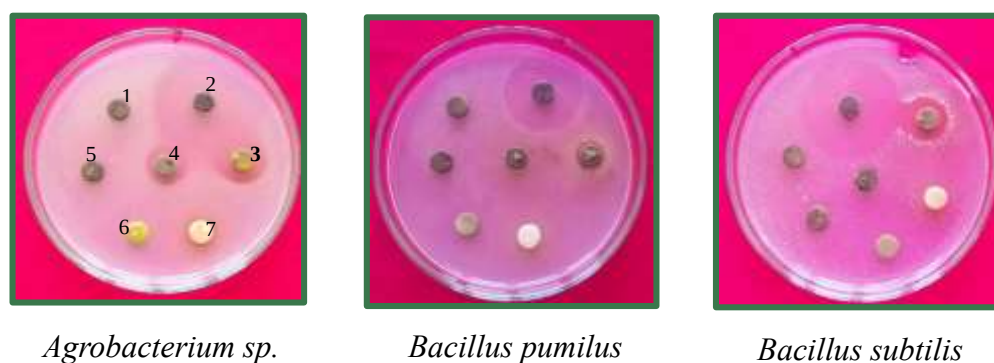
Table 4. Elemental analysis of Powdered leaves of *Operculina turpethum* (L.) Silva

No.	Elements	Percentage %
1	Calcium(Ca)	61.77%
2	Potassium(K)	25.93%
3	Iron(Fe)	9.52%
4	Copper(Cu)	1.72%
5	Strontium (Sr)	1.07%

Antimicrobial activities

Antimicrobial activities of various crude extracts from leaves of *Operculina turpethum* (L.) Silva. by using paper disc diffusion method

In this study, the presence of antimicrobial potential in different solvent extracts of *Operculina turpethum* (L.) Silva. using eight strains of test organisms were investigated as shown in Table (5) and Figures (6,7). The various crude extracts of the leaves showed the effective on three type of test organisms. The maximum antimicrobial activity was recorded in the extract of butanol by applying paper disc method.

**Figure 6.** Procedure of Antimicrobial Activities*Agrobacterium sp.**Bacillus pumilus**Bacillus subtilis***Figure 7.a** Antimicrobial activity of leaves of *Operculina turpethum* (L.) Silva. with seven extracts (1. Acetone, 2. Butanol, 3. Ethanol, 4. Ethyl Acetate, 5. Methanol, 6. Pet-ether, 7. Water)

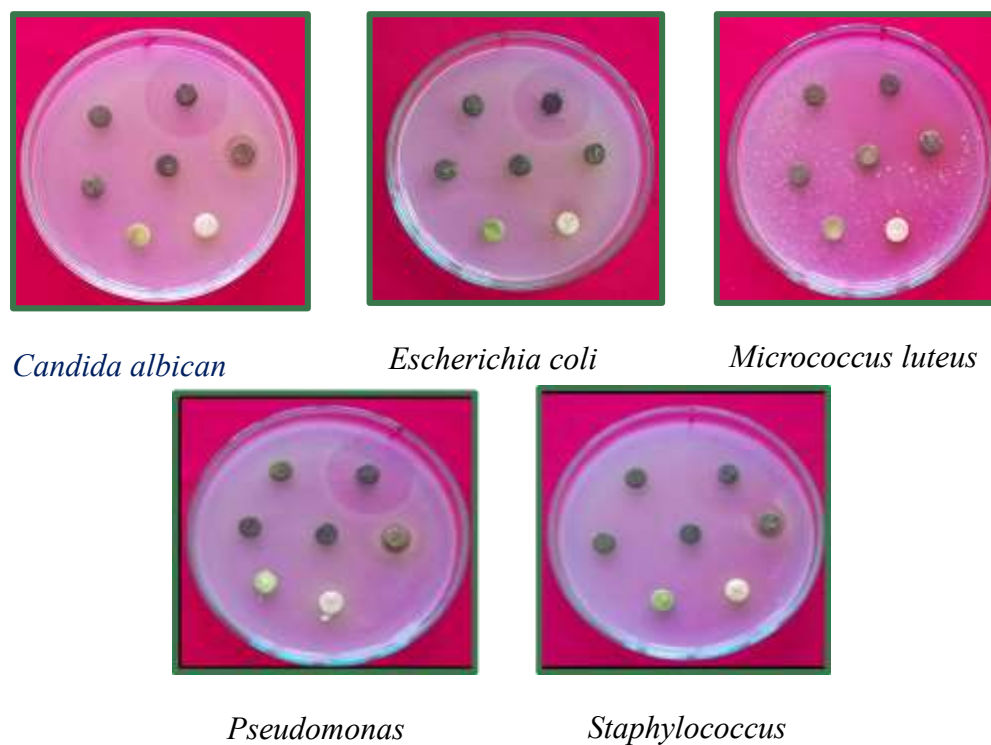


Figure 7.b Antimicrobial activity of leaves of *Operculina turpethum* (L.) Silva. with seven extracts (1. Acetone, 2. Butanol, 3. Ethanol, 4. Ethyl Acetate, 5. Methanol, 6. Pet-ether, 7. Water)

Table 5. Antimicrobial activities of leaves of *Operculina turpethum* (L.) Silva

Extracted solvent	<i>Agrobacterium</i> spp.	<i>Bacillus pumalis</i>	<i>B. subtilis</i>	<i>Candida albican</i>	<i>E. coli</i>	<i>M. furfur</i>	<i>S. aureus</i>	<i>Pseudomonas</i> spp.
Acetone	-	-	-	-	-	-	-	-
Butanol	45 mm	30 mm	40 mm	30 mm	30 mm	42 mm	32 mm	30 mm
Ethanol	15 mm	-	-	-	-	-	-	-
Ethyl Acetate	-	-	-	-	-	-	-	-
Methanol	18 mm	-	18 mm	10 mm	12 mm	25 mm	15 mm	12 mm
Pet-ether	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-

Paper disc = 6 mm

Discussion and Conclusion

In this research paper, morphological, anatomical, phytochemical studies, nutritional value, antioxidant activity, elemental analysis and antimicrobial activities of *Operculina turpethum* (L.) Silva. were studied. *Operculina turpethum* (L.) Silva. belonging to the family Convolvulaceae, was collected from Dagon University Campus in 2023.

In the present study, morphological study of *Operculina turpethum* (L.) Silva. is veins, reddish-green, 3-5 winged; latex present. Leaves alternate, simple, petiolate; the lamina broadly ovate; exstipulate. Inflorescences axillary cymes, 1-2 flowered. Sepals persistent. Petals (5), funnel-shaped. Stamens 5, epipetalous. Carpel (2), ovary superior, false septum present, tetralocular, axile placentation; the style slender; stigma bilobed, annular disc present. Fruit capsule, enclosed with enlarged sepals, the seeds black-brown in mature. Those characters are agreement with those mentioned by Dassanayake (1980), Wu *et al.* (1995) and Qi-ming (2009).

In anatomical study, in surface view of lamina, stomata are paracytic type on both surfaces, uniseriate and multiseriate non glandular trichomes were present and epidermal cells were oval to barrel shape. In transverse section of petiole and midrib, the vascular bundles were bicollateral and opened type. These characters are agreement with Metcalf & Chalk (1979); Eusa (2006), Edwin (2007) and Pandey (2008).

The preliminary phytochemical tests of powdered leaves of *Operculina turpethum* (L.) Silva. were shown alkaloid, carbohydrates, glycosides, phenolic compounds, reducing sugar, flavonoid, saponins and tannin. These data are similar to the statements describe by Trease and Evans (2002); Edwin (2007); Ali (2008), Gupta (2017), Karmakar (2021) and Pal (2024). The presence of carbohydrates and reducing sugars in this plant show the high energy content that could be utilized as a source of crude materials for pharmaceutical trades. Phenolic compounds, secondary metabolites abundantly found in both edible and non-edible plants possess biological properties of antioxidant, anti-apoptosis, anti-carcinogenic, anti-inflammatory, anti-atherosclerotic, cardiovascular protection, improvement of the endothelial function as well as inhibition of oxidative damage of DNA. Tannin has been reported to possess anti-carcinogenic and anti-mutagenic potential as well as antimicrobial properties.

The nutritional composition of powder leaves of *Operculina turpethum* (L.) Silva. have been analyzed. The powder was found to contain carbohydrates, protein, moisture, fiber, ash and fat. The fats, proteins and carbohydrates are vital nutrients for life expectancy. The carbohydrate contents are highest amount than others. Carbohydrates are involved the primary source of energy for all organism, plays vital roles of nutritional and structural. High carbohydrates contents suggest suitability of the plant as feed. Fats supply energy excess fat consumption result in cardiovascular disorder and aging. The present research about fats is lowest and totally safe for medicinal as well as for nutritional purpose. Fibers are found in suitable amount and good for the treatment of diseases like gastrointestinal disorder and obesity. Radha *et al.* (2021) also stated that the result of nutritional values of leaves of *Operculina turpethum* (L.) Silva.

Antioxidant activity also study, in this study IC₅₀ value of ethanol extract is lower than watery extract. According to the result ethanol extract of *Operculina turpethum* (L.) Silva had the lowest IC₅₀ value than water extract. Since the lower IC₅₀ values showed the higher antioxidant activities, the ethanol extract of sample was found to have effective free radical scavenging activity. These data are agreement with those mentioned by Neenu (2017).

The elements are helpful for our health. In this research work, the elemental analyses of *Operculina turpethum* (L.) Silva. include the calcium, potassium, iron, copper and strontium etc. Calcium is the mineral, it makes up the structures of our bones and teeth and also helps maintain typical muscle function, blood clotting, nerve transmission, and other body processes. Potassium is essential minerals. It maintains fluid levels in the body and supports the functioning of the kidneys, heart, muscles, and nervous system. Iron is a mineral that's an essential part of hemoglobin, a protein in red blood cells that carries oxygen from the lungs to the rest of our body Zafar (2010). Copper is an essential trace mineral necessary for survival. It is found in all body tissues and plays a role in making red blood cells and maintaining nerve cells and the immune system. Strontium is a natural element that plays a vital role in our bone health Prinessa and Peter (2015).

According to the antimicrobial activities investigation of leaves by using eight test organisms with seven extracts such as acetone, butanol, ethanol, ethyl-acetate, pet-ether, methanol and distilled water. Butanol, ethanol and methanol showed antimicrobial activity. Among them, butanol extract is the best antimicrobial activity (30-45 mm clear zone) and can affected all test organisms. The results were in mentioned with those described in Alam (2010), Tasleem Ahmad (2016), Gupta (2017) and Neenu (2017), but Alam (2010) stated that pet-ether extract of leaves also showed antimicrobial activity.

In conclusion, the botanical and phytochemical studies, nutritional value, antioxidant activity, elemental analysis and antimicrobial properties of leaves can give valuable information about *Operculina turpethum* (L.) Silva. Furthermore, medicinal plants contained numerous biologically active compounds which are helpful in improving the human life. Consumption of local vegetables can help overcome the problem of vitamin and nutritional deficiencies, especially for lower middle class population. Therefore, local vegetables are helpful as a source of carbohydrates, vitamins, fiber and minerals used for human health. Literature review observed that there is no clinical trials have been reported but controlled clinical trials to confirm its effectiveness and safety. It can be concluded that *Operculina turpethum* (L.) Silva. possess many nutritional, medicinal and pharmacological values and can also be a good curry in our homes.

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