

# Pathor Kuchi Leaf : Importance in Power Production

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## Abstract

Energy plays a vital role in modern world. World needs more and more energy. Increase in population also increases demand for energy and world is always looking for new energetic solutions that would ensure adequate global energy supply. There are also times when global energy demand is experiencing decline (global financial crisis, global recession) but these are only temporary happenings, and once they finish hunger for more energy is even bigger than it was before these temporary situations. Renewable energy sector has one very big advantage over fossil fuels, the fact that it is highly ecologically acceptable compared to fossil fuels. Because renewable energy sources release very little CO<sub>2</sub> emissions into atmosphere compared to fossil fuels as the convincingly biggest pollutants. Renewable energy sector should be heavily building on this big advantage to ensure energy dominance in coming years.

**Keywords:** PKL, Species, Medicinal Value, pH

## I. INTRODUCTION

*Bryophyllum pinnatum* has become naturalized in tropical and subtropical areas, including parts of Asia, Australia, New Zealand, West Indies, Philippines Macaronesia, Mascarenes, Galapagos Islands, Melanesia, Polynesia, and Hawaii[1-3]. In many of these, such as Hawaii, it is regarded as an invasive species[4-6]. Much of the reason for the widespread naturalization of this plant can be traced to its popularity as a garden plant. The writer Johann Wolfgang von Goethe - who also was an amateur naturalist of some repute - was "passionately fond" of this plant and liked to give the baby plantlets as gifts to friends who visited his home[7-12]. He also discussed his air plant at length in an essay titled *Geschichte meiner botanischen Studien* ("History of my botanical studies")[35-510].

## II. Methods and Materials

### II A.

#### (i) Common Names of the Pathor Kuchi Leaf

Though Pathor Kuchi Leaf has its own scientific name as well as some synonym, but it as some other local manes in different part of the world. Some of these are as below:

Air plant, Canterbury bells, Cathedral bells, Curtain plant,

Floppers, Good luck leaf, Green mother of millions, Leaf of life, Life plant, Live leaf, Live leaf plant, Live plant,

Live-leaf, Mexican love plant, Miracle leaf, Resurrection plant, Sprouting leaf, Mother of Thousands, Pregnant Leaf, Devil's Backbone[13-34].

#### (ii) Scientific classification

The scientific classification of Pathor Kuchi Leaf is:

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Saxifragales, Family: Crassulaceae, Genus : Kalanchoe, Section: Bryophyllum, Origin: Native to Madagascar and southern Africa.

#### (iii) The common cultivated species

The three most commonly cultivated species are: **1.** *Kalanchoe daigremontiana* (Syn. *Bryophyllum Pinnatum*): Devil's Backbone or mother-of-thousands. Native of Madagascar; introduced and naturalized in many parts of tropical and subtropical Africa, Asia (Indian Ocean islands), North America (Florida) and South Africa; cultivated in Pakistan.

**2.** *Kalanchoe pinnata* (Syn. *Bryophyllum calycinum*, *Bryophyllum pinnatum*): Air Plant. Native of Tropical Africa, cultivated or naturalized on many Pacific Islands (Tonga, Hawaii). It is also called the "Goethe Plant" since the famous writer Johann Wolfgang von Goethe - who also was an amateur naturalist of some repute - was "passionately fond" of this

plant and liked to give the baby plantlets as gifts to friends who visited his home. He also discussed his air plant at length in the essay which was titled *Geschichte meiner botanischen Studien* ("History of my botanical studies").

**3. *Kalanchoe delagoensis*** (Syn. *Bryophyllum delagoense*, *Bryophyllum tubiflorum*, *Bryophyllum verticillatum*)

**(iv) Some Other Species in the Section of PKL**

Some other species of Pather Kuchi Leaf are listed below:

*Kalanchoe adalae* (Syn. *Bryophyllum adalae*), *Kalanchoe beauverdii* (Syn. *Bryophyllum beauverdii*, *Bryophyllum constantinii*, *Bryophyllum juelii*, *Bryophyllum scandens*), *Kalanchoe bouvetii* (Syn. *Bryophyllum bouvetii*), *Kalanchoe campanulata*, *Kalanchoe fedtschenkoi*, *Kalanchoe gastonis-bonnierii* (Syn. *Bryophyllum gastonis-bonnierii*), *Kalanchoe laxiflora* (Syn. *Bryophyllum crenatum*), *Kalanchoe macrochlamys* (Syn. *Bryophyllum macrochlamys*), *Kalanchoe manginii* (Syn. *Bryophyllum manginii*), *Kalanchoe marnieriana* (Syn. *Bryophyllum marnierianum*), *Kalanchoe miniata* (Syn. *Bryophyllum miniatum*), *Kalanchoe prolifera* (Syn. *Bryophyllum proliferum*), *Kalanchoe pubescens* (Syn. *Bryophyllum aliciae*, *Bryophyllum pubescens*), *Kalanchoe rolandi-bonapartei* (Syn. *Bryophyllum rolandi-bonapartei*, *Bryophyllum tsaratananense*), *Kalanchoe rosei* (Syn. *Bryophyllum rosei*), *Kalanchoe schizophylla* (Syn. *Bryophyllum schizophyllum*), *Kalanchoe serrata* (Syn. *Bryophyllum lauzac-marchaliae*), *Kalanchoe streptantha* (Syn. *Bryophyllum streptanthum*), *Kalanchoe suarezensis* (Syn. *Bryophyllum suarezense*), *Kalanchoe uniflora*

**(v): Description of PKL (Pathor Kuchi Leaf)**

PKL is the abbreviation of Pather Kuchi Leaf. The scientific name of Pather Kuchi leaf is *Bryophyllum pinnatum*. It is a plant grows plenty all over Bangladesh[52-75]. The discussion about Pather Kuchi is given in figure.1 below:



Figure.1: PKL (Pathor Kuchi Leaf).

The Pather Kuchi plants are a section in the plant genus *Kalanchoe* of the Crassulaceae family. There are about twenty to thirty species in the group, native originally of South Africa, Madagascar, and Asia. The group is notable for vegetatively growing small plantlets on the fringes of the leaves; these eventually drop off and root. These plantlets arise from mitosis of meristematic-type tissue in notches in the leaves[76-90].



Figure.2: Pather Kuchi plants.

Figure.3 shows a close-up photo shows a leaf of a *Bryophyllum pinnatum*, with those tiny plantlets on the edge of the leaf. Clearly visible are the pads, where the plantlets sit and are fixed until they are ripe and fall off onto the soil to produce a new big plant. Also notice the roots growing at the bottom of each plantlet.



Figure.3: (a)Close-up photo with tiny plantlets on the edge of the leaf.(b) PKL tree in abundant area

**(vi): Distinguishing Features**

1. A fleshy upright plant usually growing 60-120 cm tall.
2. Its relatively broad leaves have scalloped margins and are oppositely arranged.
3. These leaves may be simple or compound, with three or five leaflets.
4. Its drooping bell-shaped flowers are greenish-yellow to pinkish-red in colour (up to 7 cm long).
5. These flowers are borne in branched clusters at the top of its stems.

**(vii): Habit**

A long-lived (i.e. perennial), fleshy (i.e. succulent) herbaceous plant with upright (i.e. erect) stems. It usually grows 30-120 cm tall, but can sometimes reach up to 2 m in height.

**II B. Stems and Leaves**

The upright (i.e. erect) stems are fleshy (i.e. succulent) and hairless (i.e. glabrous). The leaves are also fleshy (i.e. succulent) and are either simple (particularly on seedlings) or compound (i.e. trifoliolate or pinnate). They are oppositely arranged, flattened, and the number of leaflets present varies from one near the base of the stems to three or five (i.e. trifoliolate or pinnate) higher up the stems. These leaves (5-25 cm long and 2-12.5 cm wide) are green or yellowish-green in colour, hairless (i.e. glabrous), and are borne on stalks (i.e. petioles) 2-10 cm long [91-102]. The leaflets are oval or narrowly oval (i.e. elliptic) in shape with rounded tips (i.e. obtuse apices), and when more than one leaflet is present the end (i.e. terminal) leaflet is usually significantly larger than the others. Tiny plantlets may occasionally be formed in the scalloped (i.e. crenate) margins of these leaflets. These plantlets are more often produced if the leaves become detached from the stems.

**II C: Flowers and Fruit**

The bell-shaped (i.e. tubular), drooping (i.e. pendulous), flowers (up to 7 cm long) are arranged in branched clusters at the tips of the stems (i.e. in terminal inflorescences). Each flower is borne on a stalk (i.e. pedicel) 10-25 mm long. They have prominent, inflated, yellowish-green or pale green coloured sepals (25-55 mm long) that are partially fused into a tube (i.e. calyx tube) and streaked with pink or reddish coloured blotches. The yellowish-green to dark red coloured petals (3-6 cm long) are also partially fused into a tube (i.e. a corolla tube) that divides into four petal lobes (i.e. corolla lobes) near the tip. Flowers are produced mainly during winter and spring [92-103].

The fruit are papery and membranous (about 15 mm long), with four slender compartments (i.e. carpels). They generally remain enclosed within the old flower parts and contain numerous minute, slender, brownish-coloured seeds (less than 1 mm long).

**II D. Reproduction and Dispersal**

This plant reproduces by seed and also produces plantlets along the edges of its leaves. Its fleshy (i.e. succulent) leaves are capable of taking root and developing into new plants after being broken off the main plant or being dumped in garden waste [104-115].

**II E: Medicinal value of PKL**

*Bryophyllum pinnatum* is used in ethnomedicine generally for the treatment of earache, burns, abscesses, ulcers, insect bites, ulcers, heart-troubles, epilepsy, arthritis, diarrhea and lithiasis (Chopra et al., 1956; Agoha, 1974; Ofokansi et al., 2005). In Southeastern Nigeria, this herb is used to facilitate the dropping of the placenta of newly born baby (Dalziel, 1955). In southern Nigeria, it is used to facilitate the dropping and healing placenta wound of newly born babies [116]. The plant leaf is mildly exposed to heat and the juice extracted and applied to the baby's placenta on daily basis. The crushed leaves as well as the extracted juice are mixed with shear butter or palm oil and rubbed on abscesses or other swellings. This is also applied on ulcers, burns and on the bodies of young children when they are ill (Agoha, 1974). The juice obtained by squeezing the leaves that have been passed over fire slightly, is most commonly used for the treatment of headache, general debility, dysentery, smallpox and convulsion. One or two drops of the leaf juice is dropped into the ear for earache. A poultice of the leaves is applied over wounds and sores. The leaves can be boiled in water and the extract is given as a sedative for asthma and palpitation. Also the leave juice mixed with salt and honey is a remedy for chronic cough. The extract of dried leaves is applied to septic wound (Sofowora, 1993). In East Africa, the slightly heated leaves (heated over fire) are rubbed over the body as treatment for stiff joint and rheumatism (Gill, 1992). Other parts of the plant especially the root is prescribed for gonorrhoea, vermifuge and abortion (Sofowora, 1993). Alkaloids and saponins are present in the aqueous and alcoholic extracts of leaves and lectins in the juice from the fresh leaves (Nguelefack et al., 2006). The green callus of the plant contain malic acid, quinones and tocopherol (Sofowora, 1993; Oliver, 1989) [28].

**III. Chemical and Physical Properties of PKL**

A quantitative tests have been done at BCSIR (Bangladesh Council for Scientific and Industrial Research), Dhaka, Bangladesh. The Food & Nutrition Department of BCSIR has tested these quantitative studies [24]. The results of the quantitative tests are given by the following:

1. The existence of the main constituent elements of Pathor Kuchi Leaf is  $Fe^{++}$  and  $Cl^-$ .
2. Titratable Acidity of the PKL is 0.88%.

Further qualitative tests have to be done at the Food & Nutrition Department at BCSIR, Dhaka. The quantitative tests were done by **Dr. Barun Kanti Saha**, Senior Scientific Officer (SSO), **Institute of Food Science & Technology (IFST) BCSIR**, Kudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh in December, 2008.

#### IV. Description of pH

In chemistry,  $p^H$  is a measure of the acidity or basicity of an aqueous solution. Solutions with a  $P^H$  less than 7 are said to be acidic and solutions with a  $p^H$  greater than 7 are basic or alkaline. Pure water has a  $p^H$  very close to 7[28-32].

##### IV A: The Simple Definition

$p^H$  is a logarithmic measure of hydrogen ion concentration, originally defined by Danish biochemist Søren Peter Lauritz Sørensen in 1909.

$$p^H = -\log[H^+]$$

where, log is a base 10 logarithm and  $[H^+]$  is the concentration of hydrogen ions in moles per liter of solution. According to the Compact Oxford English Dictionary, the "p" stands for the German word for "power", *potenz*, so  $p^H$  is an abbreviation for "power of hydrogen".

##### IV B. The Theoretical Definition

$p^H$  has been more accurately defined as:  $P^H = -\log a_{H^+}$ ,

where  $a_{H^+}$  is the hydrogen ion *activity*. In solutions that contain other ions, activity and concentration are not the same. The activity is an *effective* concentration of hydrogen ions, rather than the true concentration; it accounts for the fact that other ions surrounding the hydrogen ions will shield them and affect their ability to participate in chemical reactions. These other ions effectively change the hydrogen ion concentration in any process that involves  $H^+$ .

##### IV C. The Experimental Definition

IUPAC has endorsed a  $p^H$  scale based on comparison with a standard buffer of known  $p^H$  using electrochemical measurements. The IUPAC  $p^H$  scale is very slightly different from the theoretical definition, since it considers factors that are not included in the (thermodynamic) theoretical  $p^H$ .

##### IV D. $p^H$ scale

The  $p^H$  scale takes its name from the words *potential of hydrogen*. It is a scale used to measure the acidity or alkalinity of a solution. The  $p^H$  scale uses a range from 0 to 14, with 7.0 indicating neutrality. Numbers beginning at 7.0 and moving toward 0 indicate acidity, while the numbers beginning at 7.0 and moving toward 14 indicate alkalinity. There are several categorizations for solutions as measured by the  $p^H$  scale. A common one is this:

**Table .1:  $p^H$  scale**

$P^H$ Value	Indication
0 - 2	Strongly acidic
3 - 5	Weakly acidic
6 - 8	Neutral
9 - 11	Weakly basic
12 - 14	Strongly basic

It is interesting to note that while some people associate corrosion with acid, a number of organizations define  $p^H$ 's of both 0-2 and 11.5-14 as corrosive.

##### IV E. Importance of pH

Electricity generation is high from that solution whose mixture's  $p^H$  is low. Liquid mixture of PATHOR KUCHI LEAF's  $p^H$  is only 4.6. A solution whose  $p^H$  is 7 is said to be neutral, that is, it is neither acidic nor basic. Water is subject to a self-ionization process. The  $p^H$  of distilled water at room temperature is about 5.7[33].

##### IV E. $p^H$ of the PKL

The  $p^H$  of Pathor Kuchi malt without water is 4.6. The  $p^H$  of Pathor Kuchi malt with water (10% solution) is 4.8.

##### IV E. Titratable Acidity for PKL

Titratable acidity measures the amount of alkali required to neutralize the components of a given quantity of milk and milk products, and is expressed as percentage of lactic acid. This test is used to determine milk quality and to monitor the

progress of fermentation in cheese and fermented milks[34]. In the BCSIR laboratory a quantitative tests have been done and shown that the titratable acidity of PKL is 0.88%.

## V. Contents of Patherkuchi Leaf

The plant Patherkuchi Leaf (*Bryophyllum Pinnatum*) is using for medicinal plant all over the world from many decades. Since it has a lot of madicinal value people called it as various names, like Air Plant, Life Plant, Miracle Leaf, Goethe Plant etc. A phytochemical analysis is very useful in the evaluation of some active biological compound of some medicinal plants.

To find out the contents of this leaf a lot of researches were carried out. A research carried out by the Department of Biochemistry, Ebonyi State University, Abakaliki, P.M.B 053 Abakaliki, Nigeria on both dry and fresh sample<sup>21</sup>. This shows that *Bryophyllum Pinnatum* contain appreciable amount of bioactive compounds. The results revealed the presence of bioactive constituents comprising alkaloids (0.89 +- 0.02 µg/g and 0.37 +- 0.01µg/g), Saponins (0.35 +- 0.01% and 0.17 +- 0.01%), Flavonioids (0.08 +- 0.01 µg/g and 0.03 +- 0.02 µg/g), and Tannins (1.24 +- 0.16% and 0.81 +- 0.02%) for both dry and fresh samples respectively[35].

Table.2 summarizes the qualitative phytochemical analyses of *Bryophyllum Pinmatum*. The result shows the presence of alkaloid, saponins, flavounoids, tannins and absence of glycosides. The result of quantitative determination of phytochemical constituents of *Bryophyllum Pinmatum* is shown in table 9.3. High quantity of Tannins alkaloids and Saponins were found on *Bryophyllum Pinnatum*. The values of flavonioids were very trace on the plant.

**Table.2:Qualitative phytochemical data of *Bryophyllum Pinnatum* leaves**

Phytochemicals	Leaves
Alkaloids	+ve
Saponins	+ve
Tannins	+ve
Flavonoids	+ve
Glycosides	-ve

**Table .3: Phytochemical composition (Quantitative) of the leaves of *Bryophyllum Pinnatum* expressed as mg/100g dry and fresh weight.**

SI No.	Phytochemical	Dry	Fresh
1	Alkaloids	0.89 + 0.10	0.37 + 0.06
2	Saponins	0.35 + 0.01	0.17 + 0.01
3	Flavonoids	0.08 + 0.01	0.03 + 0.02
4	Tannins	0.24 + 0.16	0.81 + 0.02

Results are mean + standard deviation of triplicate determination on both dry and fresh samples. In a study was conducted by Centre for Studies in Biotechnology, Dibrugarh University, Dibrugarh, Assam-786004, India for the constituent of *Bryophyllum Pinnatum*. In the research it was pointed out that Total phenolic contents in *Bryophyllum Pinnatum* obtained were 18.4mg/gm, and total flavonoid contents obtained were 8.4mg/gm. The details show the following Table 9.4<sup>22</sup>.

**Table.4: Phytochemical constituents of *Bryophyllum Pinnatum* (leaves).**

Phytochemical	Leaves
Proteins	+ve
Carbohydrates	+ve
Phenols/Tannins	+ve
Flavonoids	+ve
Saponins	+ve
Glycosides	+ve
Steroids	+ve
Terpenoids	+ve
Alkaloids	+ve

A full length research was conducted by Department of Chemistry, Michael Okpara University of Agriculture, Umudike, P.M.B. 7267, Umuahia, Abia State, Nigeria to analyze for their Chemical composition, vitamins and minerals[36].

Table 9.5 summarizes the quantitative determination of phytochemical constituents of *Bryophyllum Pinnatum*.

Table .5: Phytochemical composition of the leaves of *bryophyllum pinnatum* expressed as mg/100g dry weight.

Phytochemicals	<i>Bryophyllum pinnatum</i>
Alkaloids	1.48 ± 0.02
Flavonoids	1.72 ± 0.11
Phenols	1.86 ± 0.11
Tannins	0.51 ± 0.20

The mineral contents of both plants are shown in Table .6.

Table.6: Mineral composition of *Bryophyllum pinnatum* leave as mg/100g dry weight.

Minerals	<i>Bryophyllum pinnatum</i>
<b>Macroelements</b>	
Magnesium	0.10 ± 0.20
Calcium	0.32 ± 0.10
Potassium	0.04 ± 0.11
Phosphorus	0.18 ± 0.22
Sodium	0.02 ± 0.10
<b>Macroelements</b>	
Iron	1.85 ± 0.20
Zinc	5.38 ± 0.11

It shows that Calcium was the most abundant macro element present 0.32 mg/100 g. This is followed closely by phosphorus, which was present 0.18 mg/100 g. Zinc was present at 5.38 mg/100g[37]. The results also shows that the *Bryophyllum pinnatum* is also reach in Vitamins. Ascorbic acid (vitamin C) was found to be 44.03 mg/100g in it. Table.7 shows in detail.

Table.7: Vitamin compositions of *Bryophyllum pinnatum* on mg/100g dry weight

Vitamin	<i>Bryophyllum pinnatum</i>
Ascorbic acid	44.03 ± 0.20
Riboflavin	0.42 ± 0.10
Thiamine	0.18 ± 0.02
Niacin	0.02 ± 0.10

To find out the contents of the chemical and nutritional analysis of *Vernonia amygdalina*, *Bryophyllum pinnatum*, *Eucalyptus globules* and *Ocimum gratissimum* a study was jointly conducted at Department of Plant Science and Applied Zoology, Olabisi Onabanjo University, P.M.B. 2002, Ago-Iwoye, Ogun State, Nigeria and Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, P.M.B. 5029, Ibadan, Nigeria by D.A. Alabi, M.Z. Onibudo<sup>1</sup> and N.A. Amusa<sup>24</sup>. The result shows that the minerals of *Bryophyllum pinnatum* contains Sodium (Na), Calcium (Ca), Potassium (K), Phosphorus (P), Magnesium (Mg), Manganiz (Mn), Iron (Fe), Copper (Cu), and Zinc (Zn). The components of those in g/100g are shown in table 9.8 below. It shows that the Potassium contain in *Bryophyllum Pinnatum* is 90.25 mg/100g. It contain 5.94 mg Copper and 7.92 mg Zinc per 100g of *Bryophyllum Pinnatum*[30].

Table .8: Mineral composition of *Bryophyllum pinnatum* (mg/100 g).

Minerals	<i>Bryophyllum pinnatum</i>
Na	7.65
Ca	65.40
K	90.25
P	60.46
Mg	87.62
Mn	5.10
Fe	14.13
Cu	5.94
Zn	7.92

## VI: Conclusions

The *Bryophyllum pinnatum* is really a miracle leaf. It has a great medicinal value. Many researchers have going on it as well as the content of the leaf. This leaf has a large source of many minerals, vitamins and acid also. It is a new invention that this leaf can produce electricity. This invention is going to be a wonderful and valuable invention in recent future.

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