

## PHARMACOGNOSTIC COMPARISON OF *BACOPA MONNIERI*, *CYPERUS ROTUNDUS*, AND *EMBLICA OFFICINALIS*

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### ABSTRACT

In the last few decades, a curious thing has happened to Herbal medicines. Instead of being killed off by medical science and pharmaceutical chemistry, it has made come back. Herbal medicine has benefited from the objective analysis of the medical science, while fanciful and emotional claims for herbal cures have been thrown out, herbal treatments and plant medicine that works have been acknowledge. Moreover, herbal medicine has been found to have impressive credentials. Developed empirically by trial and error, many herbal treatments were nevertheless remarkably effective. In a recent survey estimated that 39% of all 520 new approved drugs in 1983-1994 were natural products or derived from natural products and 60-80% of antibacterial and anticancer drugs were derived from natural products. Medicinal plants play an important role in the development of potent therapeutic agents. Plant-derived drugs came into use in the modern medicine through the uses of plant material as an indigenous cure in folklore or traditional systems of medicine. *Bacopa monnieri*, *Cyperus rotundus*, and *Emblica officinalis* (Brahmi, Nagarmotha, Amla) have several chemical compounds have been isolated from these herbs which are useful in treating number of diseases such as diarrhea, vomiting, indigestion, antibacterial, antifungal, antiviral, hair growth, hair wash, antioxidant, anticonvulsant, analgesic, anti-allergic, antifungal, cardiac depressant, and cardio-tonic. These reported therapeutic activities are due to the presence of phytochemicals present in these Herbs. Even Ayurveda has recognizes the nutritional elements derived from foods and Rasayanas which help to optimize the availability of "essential nutrients" in the body.

**Keywords:** *Bacopa monnieri*, *Cyperus rotundus*, *Emblica officinalis*, Medicinal plants, Antibacterial, Cardio-tonic, Hair growth, Herbal plants, Ayurveda, Brahmi, Nagarmotha, Amla, Essential nutrients, Herbal cosmetics, Physico-chemical, Chemical constituents, Inorganic components, Phytoconstituent, Pharmacological and traditional properties.

### INTRODUCTION

Herbal drugs constitute only those traditional medicines which primarily use medicinal plant preparations for therapy. The earliest recorded evidence of their use in Indian, Chinese, Egyptian, Greek, Roman and Syrian texts dates back to about 5000 years. The classical Indian texts include Rigveda, Atharvaveda, Charak Samhita, and Sushruta Samhita. It is estimated that around 70,000 plant species, from lichens to towering trees, have been used at one time or another for the medical purposes [1]. Plant kingdom has played an initial role in the existence of living beings on this earth. Without them, animal's life would have been lifeless world of deserts. They fulfill important necessities of life-food, clothing, shelter, and host to many living beings. The history of herbal medicine is as old as human civilization [2].

Today there is demand of such formulations, which are not having side effects to them. Pure herbal cosmetics preparations are having some problems regarding their stability. Nowadays cosmetology is a well-defined science based on experiences gathered over centuries. The safety and efficacy of natural herbs could not find any suitable match, i.e., cannot be replaced by synthetics [3]. There is once again revival of preference for natural products. Diet, nutrition, exercise, yoga, and meditation, i.e., holistic approach is essential nowadays. Nowadays herbal extracts and powders are used in the preparation to increase beauty and attractiveness of the person. In the present work, we have selected three such herbal drugs which are namely *Bacopa monnieri*, *Cyperus rotundus*, and *Emblica officinalis* [4] as they have been used by the traditional tribal communities as medicines for treating various diseases. Many of the workers worked on these herbal drugs and reported their uses in different ways with their pharmacological properties and pharmacognostic properties [5]. According to pharmacopoeia, these drugs have their properties as shown in Table 1 [6].

### *B. monnieri* (Brahmi)

It is a glabrous, succulent, small, prostrate or creeping annual herb, found throughout India in wet and damp places. The name *B. monnieri* (Brahmi) is derived from the word "Brahma," the mythical "creator" in the Hindu pantheon. Because the brain is the center for creative activity, any compound that improves the brain health is called *B. monnieri* (Brahmi), which also means "bringing knowledge of the supreme reality" in India [7].

The herb is from a family *Scrophulariaceae* and is a small creeping herb with numerous branches, small oblong leaves and light purple or small and white flowers, with four or five petals. It is found in wetlands throughout the Indian subcontinent in damp and marshy or sandy areas near streams in tropical regions. The genus *Bacopa* includes over 100 species of aquatic herbs distributed throughout the warmer regions of the world, apart from India, Nepal, Sri Lanka, China, Taiwan and Vietnam and is also found in Florida and other southern states of the USA. The entire plant is used medicinally [8].

### Taxonomical classification of *B. monnieri*

- Class: Dicotyledoneae
- Common names: Brahmi, Nira-brahmi, Jalabrahmi, Thyme-Leaved Gratiola
- Division: Anthophyta
- Family: Scrophulariaceae
- Genus: *Bacopa*
- Kingdom: Plantae
- Order: Scrophulariales
- Species: *Monnieri*

### Vernacular names of *B. monnieri*

- English: Thyme Leaved Gratiola
- Gujarati: Neerbrahmi, Bamaneveri
- Hindi: Mandukaparni
- Malayalam: Brahmi

- Marathi: Jalnam, Brahmi, Brahmi
- Oriya: Brahmi
- Punjabi: Brahmibuti
- Sanskrit: Sarasvati
- Telugu: Sambarenu, Sambrani
- Urdu: Brahmi

#### Plant morphological description of *B. monnieri* [7,9]

##### Flowers

Pale blue or pinkish white, nearly regular, solitary axillary, 0.6-3 cm in length, usually longer than leaves with two linear bracteoles, pedicel slender, calyx glabrous, deeply 5 partite, corolla gamopetalous, stamens 4, didynamous, anthers 2 celled, pistil bicarpellary, syncarpous, ovary two chambered with many ovules, style dilated towards the top, and stigma bilobed (Fig. 1).

##### Fruits

Globose to ovoid, glabrous capsule, 5 mm in length, enclosed with persistent calyx, pedicel 1-3 cm long purplish when fresh.

##### Leaves

Simple, opposite and decussate, somewhat sessile, glabrous, obovate-oblong to spatulate in shape, 0.6-2.5 cm in length and 3-8 mm in width, entire, lower surface is with minute specks, obscurely 1-3 nerved, color faint green (Fig. 1).

##### Roots

Fragments of dried main roots are cylindrical, about 5 mm in diameter, longitudinally wrinkle, and off white in color.

##### Seeds

Numerous, very minute, <1 mm wide, oblong, or irregular.

##### Stem

Pieces of stem are cylindrical, glabrous, nodes prominent at places attached with vertically growing branches and ventrally to cluster of tortuous, brittle roots, internodes about 1-1.5 cm in length and 3-4 mm in diameter, pale yellowish green with a purplish tinge (Fig. 1).

#### Organoleptic characters of *B. monnieri*

Qualitative evaluation based on the sensory profile by observation of color, odor, taste, and consistency given in Table 2.

#### Physico-chemical properties of *B. monnieri*

Loss on drying, total ash, acid insoluble ash, water soluble ash, water-soluble extractive, moisture content, pH, and alcohol soluble extractive values were calculated as per Indian pharmacopoeia (Table 3) [10].

#### Chemical constituents of *B. monnieri*

*Bacopa monnieri* indicated the presence of alkaloids, Brahmine, and herpestine. The major bioactive constituent of the plant is tetracyclic triterpenoid saponins, bacosides A and B (crystalline mixture of several saponins). Among these, bacoside A is predominant. Other saponins include bacosides A1 and A3, bacopasaponins A, B, C, D, E, and F. The other minor compounds include alkaloids (*viz.*, herpestine and Brahmin) and flavonoids (*viz.*, luteolin-7glucoside, glucuronyl-7-apigenin and glucortonyl-7-luteolin, common phytosterols) (Table 4 and Fig. 2) [11].

#### *C. rotundus* (Nagarmotha)

*Cyperus Rotundus* It is a perennial shrub that attains a height of up to 40 cm, it has a dark green thin stem and the leaves are long and sharp, with a width of 1/6 to 1/3 inch. While the flower stem has a triangular cross-section, the flower is 2 to 8 inch in length, has three-stamina and a three-stigma carpel. It is also bisexual [12].

*C. rotundus* L. (purple nut sedge) belonging to the family Cyperaceae, it is a perennial herb, indigenous to India and found in tropical and subtropical regions throughout the world. It is a notorious weed and has a destructive effect on agricultural yields after it invades the crop fields.

The plant is considered an invasive weed; it has been called "the world's worst weed." The plant requires sun and moist conditions, though it grows in sandy soil, as well as in loamy moist fields and in tropical rainforests. It is especially prevalent in southern India, where its essential oil is used in perfumery. As an invasive weed, it is considered troublesome in 92 countries and adversely affects more than 50 crops,



Fig. 1: Flower & whole plant of *Bacopa Monnieri* (Brahmi)

Table 1: Properties, action, formulations and therapeutic uses of *B. monnieri*, *C. rotundus*, *E. officinalis*

<i>E. officinalis</i>	<i>C. rotundus</i>	<i>B. monnieri</i>
Properties and action		
Rasa: Madhura, Amla, Katu, Tikta, Kasaya	Rasa: Katu, Tikta, Kasaya	Rasa: Madhura, Tikta, Kasaya
Guna: Laghu, Ruksa	Guna: Laghu, Ruksa	Guna: Laghu, Sara
Virya: Sita	Virya: Sita	Virya: Sita
Vipaka: Madhura	Vipaka: Katu	Vipaka: Madhura
Karma: Tridosajit, Vrsya, Rasayana, Caksuya	Karma: Sothahara, Dipana, Grahi, Krmighna, Pacana, Visaghna, Pittakaphahara, Sthoulyahara	Karma: Kaphahara, Medhya, Rasayana, Svarya, Vatahara, Visahara, Ayusya, Matiprada, Prajasthapana, Mohahara
Important formulations		
Cyavanaprasa	Musakarista, Mustakadi Kvatha, Asokarista, Mustakadi Curna, Mustakadi, Mustakadi Lehya, Dhmya Pancaka Kvatha Curna, Piyusavalli Rasa	Sarasvatarista, Brahmi Ghrta, Ratnagiri Rasa, Brahmi, Vati, Sarasvata Curna, Smrtisagara Rasa
Therapeutic uses		
Raktapitta, Amlapitta, Prameha, Daha	Agnimandya, Ajerna, Jvara, Sangrahani, svasa, Kasa, Mutrakrcchra, Vamana, Stanyavikara, Sutikaroga, Atisara, Amavata, Krimiroga.	Kustha, Jvara, sophia, Pandu, Prameha, Manasavikara

*E. officinalis*: *Emblca officinalis*, *C. rotundus*: *Cyperus rotundus*, *B. monnieri*: *Bacopa monnieri*

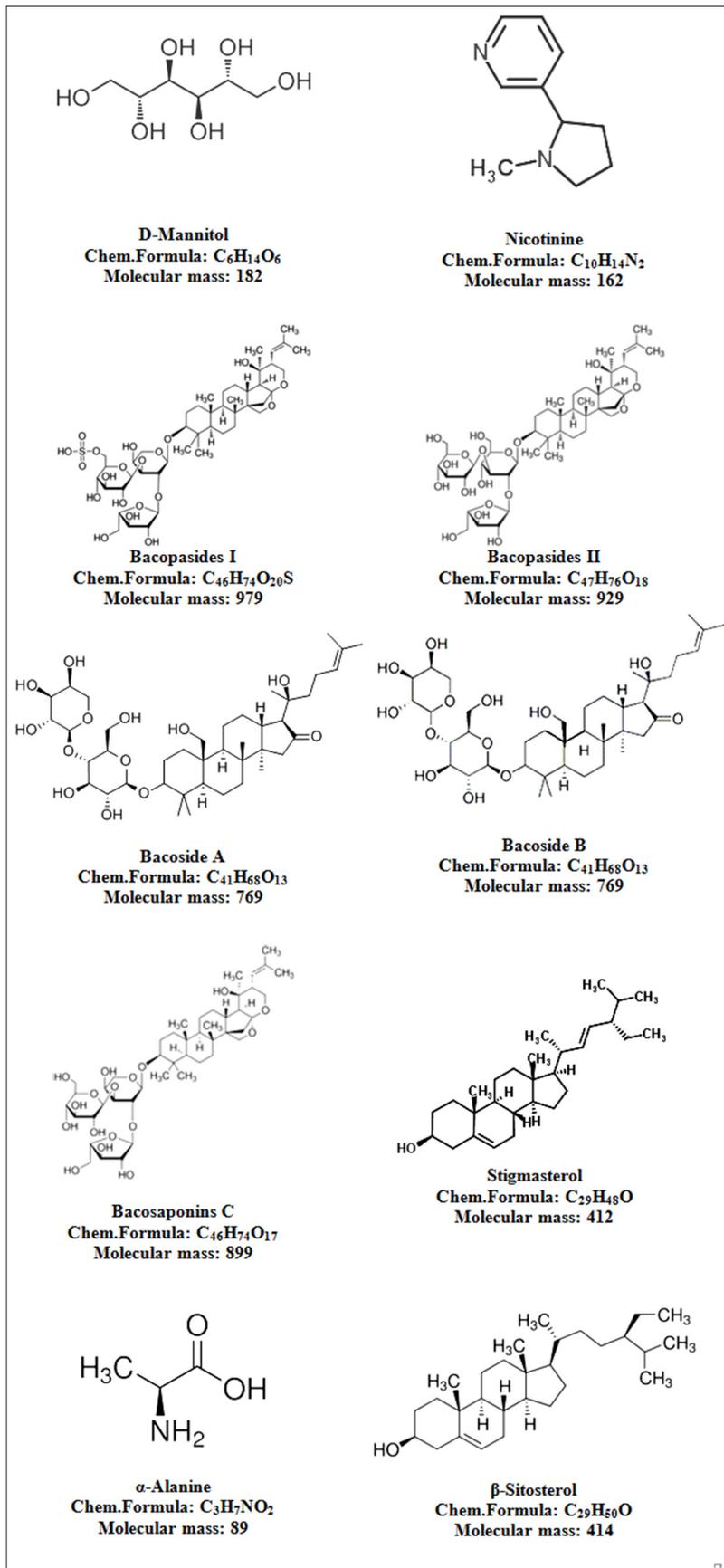


Fig. 2: Chemical constituents present in *Bacopa Monnieri* (Brahmi)

Table 2: Organoleptic characters of *B. monnieri* (Brahmi)

Serial number	Plant parts	Parameters	Observations
1	Flowers	Colour Consistency Odour Taste	Blue or white Soft, smooth Slightly aromatic Bitter
2	Fruits	Colour Consistency Odour Taste	Green Soft, smooth Bitter Bitter
3	Leaves	Colour Consistency Odour Taste	Greenish brown Smooth Pungent Bitter-astringent
4	Powder	Colour Consistency Odour Taste	Greenish brown Rough Characteristic Bitter
5	Stem	Colour Consistency Odour Taste	Brownish green Soft, smooth Pungent Bitter

*B. Monnieri: Bacopa monnieri*

Table 3: Physico-Chemical properties of *B. monnieri* (Brahmi)

Serial number	Parameters	Observations (%)
1	Acid insoluble ash (w/w %)	1.3
2	Alcohol soluble extractive value (w/w %)	28
3	Foreign matter	1.8
4	Loss on drying (w/w %)	12.50
5	Moisture content	88.4 g/100 g
6	pH value	6.8
7	Total ash (w/w %)	18.0
8	Water soluble extractive value	22.70

*B. Monnieri: Bacopa monnieri*

Table 4: Chemical constituents present in various parts of *B. Monnieri: (Brahmi)*

Parts	Chemical constituents
Flowers, Fruits, Leaves, Root, Stem	Aspartic acid, bacogenin A1, A2, A3, A4, bacopasides I, II, III, IV and V, bacosaponins A, B, C and D, bacoside A and B, bacosine, bacosterol, betulinic acid, brahmine, D-mannitol, glutamic acid, herpestine, nicotine, pseudojujubogenin glycoside, stigmaterol, $\alpha$ -Alanine, $\beta$ -Sitosterol

*B. Monnieri: Bacopa monnieri*

including sugar cane, corn, cotton, rice, and many vegetables. Cyperus grows rapidly and fills the soil with its tangle of roots and rhizomes; this one species (*C. rotundus*) can produce up to 40,000 kg/hectare of underground plant material. The plant prefers light (sandy) and medium (loamy) soils. The plant prefers acid, neutral and basic (alkaline) soils. It cannot grow in the shade. It requires moist or wet soil [13].

#### Taxonomical classification of *C. rotundus*

- Class: Liliopsida
- Division: Magnoliophyta
- Family: Cyperaceae
- Genus: Cyperus L.
- Kingdom: Plantae
- Order: Cyperales
- Species: *C. rotundus* L.

- Subclass: Commelinidae
- Subkingdom: Tracheobionta
- Superdivision: Spermatophyta

#### Vernacular names of *C. rotundus*

- Assam: Mutha
- Bengal: Moothoo, mutha
- English: Nut grass, Purple nut sedge
- Gujarat: Moth, Nagarmotha
- Hindi: Nagarmotha, Motha
- Kannada: Konnari Gadde
- Latin name: *C. rotundus*
- English name: Nut grass
- Indian name: Mustaka, Nagarmotha, Motha
- Marathi: Moth, Nagarmotha, Bimbal
- Punjab: Mutha, Motha
- Sanskrit: Bhadramusta, Mutha
- Tamil: Korai
- Telugu: Tungamustalu
- Urdu: Sad Kufi

#### Plant morphological description of *C. rotundus* [14]

##### Flowers

Inflorescence is spike or panicle or gloose head, but the unit of inflorescence is a spikelet. In spikelet there may be one or more flowers, but each is brone in the axil of a giume and is minute in size, flowering in July/August, flowers red brown to almost black, unisexual or bisexual (Fig. 3).

##### Leaves

Simple, alternate, tristichous; Leaf dark green above, with reddish brown sheaths, clustered at the base of stem, ligule absent, sheath closed (Fig. 3).

##### Rhizomes

Rhizome many, slender; Tuber-white, succulent when young, hard and black when mature (Fig. 3).

##### Seeds

Albuminous (Fig. 3).

##### Stem

Stem-leafy at base arising from a tuber. Culm-dark green, glabrous. Stem solid, usually triangular (Fig. 3).

#### Organoleptic characters of *C. rotundus*

Qualitative evaluation based on sensory profile by observation of color, odor, taste, and Consistency given in Table 5.

#### Physico-chemical properties of *C. rotundus*

Total ash, acid insoluble ash, water soluble ash, white starch content, water-soluble extractive, alcohol soluble extractive, viscosity, and amylose content values were calculated as per Indian pharmacopoeia (Table 6) [15].

#### Chemical constituents of *C. rotundus*

Phytochemical studies have shown that the major chemical components of this herb are essential oils, flavonoids, terpenoids, mono- and sesquiterpenes. The plant contains the following chemical constituents are shown in Fig. 4 and Table 7 [16].

#### *Emblica officinalis* (Amla)

*E. officinalis* (Amla) is a prestigious herb finds it mention in Charak Samhita as a Rasayan. Rasayan is a thing that prevents aging and promote longevity. Extensively used herb in making Ayurvedic medicines because of its miraculous actions. According to Ayurvedic

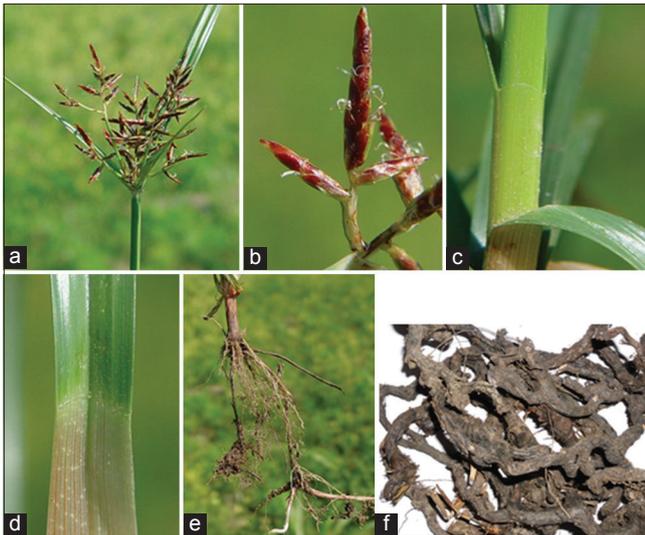


Fig. 3: (a) Fruits, (b) Flowers, (c) Stem, (d) Leaves, (e) Roots, (f) Rhizomes of *Cyperus Rotundus* (*Nagarmotha*)

Table 5: Organoleptic characters of *C. rotundus* (*Nagarmotha*)

Serial number	Parameters	Observations
1	Colour	Dark brown or black externally and internally creamish-yellow
2	Consistency	Slightly tuberous at the base
3	Odour	Pleasant, Fragrant
4	Taste	Slightly pungent, bitter and astringent

Table 6: Physico-chemical properties of *C. Rotundus* (*Nagarmotha*)

Serial number	Parameters	Observations (%)
1	Acid soluble Ash (w/w %)	3.00
2	Alcohol soluble extractive (w/w %)	9.068
3	Adhesive strength and line-spread	50°C
4	Amylose content	26.73
5	Total ash	5.9-6.35
6	Viscosity	20°C
7	Water soluble ash	1.10
8	Water soluble extract	16.36
9	White starch content	24.1

*C. rotundus*: *Cyperus rotundus*

Table 7: Chemical constituents present in various parts of *C. Rotundus* (*Nagarmotha*)

Parts	Chemical constituents
Arial	Ammiol, Bezo- $\alpha$ -pyrone (coumarin), caffeic acid, furochromones, Isohamnetin, khellin, pcoumaric acid, protocatechuric acid, salicylic acid, sitosteryl (6-hentriacontanoyl)- $\beta$ -D galactopyranoside, triclin, visnagin
Leaves	Auresidin, Luteolin
Rhizomes	Calcium, caryophyllene, camphene, copaene, cyperene, cyperenone, cyperol, cyperotundone, cyperolone, D-copadiene, D-epoxyguaiene, isocyperol, isokobusone, kobusone, limonene, linoleic acid, linolenic acid, mustakone, myristic acid, oleanolic acid, oleic acid, P-cymol, patchoulone, rotundene, rotundenol, rotundone, selinatriene, sitosterol, stearic acid, sugeonol, sugetriol, $\alpha$ -cyperolone, $\alpha$ -rotunol, $\beta$ -cyperone, $\beta$ -pinene, $\beta$ -rotunol, $\beta$ -selinene
Essential Oil	2-methoxy-8-methyl-1,4-naphthalenedione, 4, 4 $\alpha$ -5, 6, 7, 8-hexahydro-4 $\alpha$ -5dimethyl-3-(1-methyl ethylidene)-2 (3H)-naphthalenone, Cyperene, Fructose, Glucose, Logipinocarvone, Oxo- $\alpha$ -ylangene, Protein, Starch, $\alpha$ -copaene, $\alpha$ -cyperone, $\alpha$ -gurjunene, $\alpha$ -hisaholene, $\beta$ -selinene

*C. rotundus*: *Cyperus rotundus*

doctors regular usage of Amla will make you live more than 100 years like a youth [17]. Amla is supposed to rejuvenate all the organ systems of the body, provide strength and wellness. It keeps us away from all the diseases by boosting our immune system. It is believed by Ayurvedic practitioners that if an individual regularly takes Amla he can live up to an age of 100 without suffering from any type of ailments. *E. officinalis* (Amla) it is a small or medium sized tree, found in mixed deciduous forests, ascending to 1300 m on hills and cultivated in gardens and homeyards.

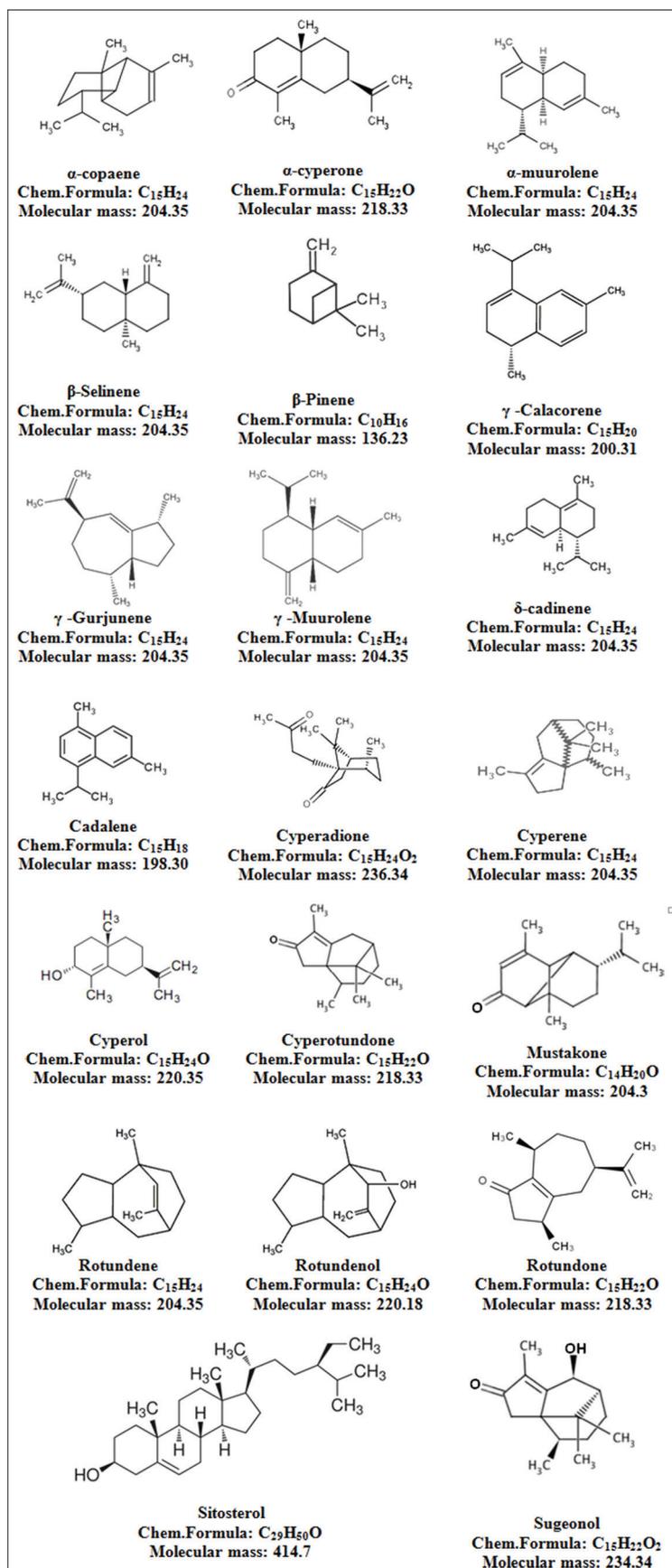
Fresh fruit is refrigerant, diuretic, and laxative. Fruit is also used as carminative and stomachic. Dried fruit is sour and astringent. Bark is astringent. The herb is also aphrodisiac, hemostatic, nutritive tonic, and rejuvenative. It increases red blood cell count. *E. officinalis* (Amla) is one of the highest natural sources of Vitamin C (3,000 mg per fruit). Amla fruit paste is main ingredient of Chyawanprash, a popular Ayurvedic tonic. Amla is known as Amritphale in Sanskrit, which literally means the fruit of heaven or nectar fruit [18].

**Taxonomical classification of *E. officinalis***

- Class: Dicotyledonae
- Division: Angiospermae
- Family: Euphorbiaceae
- Genus: Emblica
- Kingdom: Plantae
- Order: Geraniales
- Species: *Officinalis* Gaertn.
- Synonym: *Phyllanthus emblica* Linn

**Vernacular names of *E. officinalis***

- Assam: Amlaku, Amalaki, Amalaku
- Bengali: Dhatri
- Chinese: An mole
- English: Emblic myrobalan, Indian Gooseberry
- French: Phyllanthe Emblica
- German: Amla
- Gujarati: Ambla
- Hindi: Amla
- Italian: Mirabolano emblico
- Kannada: Nelli Kayi
- Karnataka: Nellikayi, Bela nelli
- Kashmir: Aonla
- Malayalam: Nelli Kayi
- Malaysian: Popok Melaka
- Marathi: Amla
- Orissa: Anala, Ainla
- Punjabi: Aula, Amla
- Sanskrit: Dhatriphala, Amla, Amaliki, Amalakan, Sripthalam, Vayastha
- Tamil: Nelli
- Telugu: Usirikaya

Fig. 4 : Chemical constituents present in *Cyperus Rotundus* (Nagarmotha)

**Plant morphological description of *E. officinalis* [19,20]**

**Bark**

Thin light grey bark exfoliating in small thin irregular flakes (Fig. 5).

**Flowers**

Small, inconspicuous, and greenish-yellow flowers are borne in compact clusters in the axils of the lower leaves. Male flowers are unisexual and numerous on short slender pedicels, females few, sub sessile, ovary 3 celled (Fig. 5).

**Fruit**

Pale yellow, depressed, fleshy, globose, about 2 cm in diameter with 6 obscure vertical furrows enclosing 6 trigonous seeds in 2 seeded 3 crustaceous cocci (Fig. 5).

**Leaves**

They are 3 mm wide and 1.25-2 cm long, alternate, bifarious, pinnate, leaflets numerous, alternate, linear-obtuse, entire, petioles are striated, round (Fig. 5).

**Seeds**

Obovate-triangular, 3 celled, seeds 2 in each cell (Fig. 5).

**Organoleptic characters of *E. officinalis***

Qualitative evaluation based on sensory profile by observation of color, odor, taste, and consistency given in Table 8.

**Physico-chemical properties of *E. officinalis***

Total ash, acid insoluble ash, water-soluble extractive, alcohol soluble extractive, pH, Powder microscopic, disintegration time, loss on drying values were calculated as per Indian pharmacopoeia (Table 9) [6].

**Nutritive value**

*E. officinalis* (Amla) has been called the first-rate of the Ayurvedic rejuvenating herb, considering by way of the usual stability of tastes (sweet, sour, pungent, bitter and astringent) multi-function fruit and is well identified for its dietary characteristics. *E. officinalis* (Amla) fruit is regularly the richest recognized normal source of Vitamin C (200-900 mg/100 g of safe to eat component). The fruit juice involves close to 30 instances as so much Vitamin C as orange juice and a single fruit is the same as antiscorbutic value to at least one or two oranges. It also involves minerals and amino acids akin to calcium, phosphorus, iron, niacin, carotene, thiamine, riboflavin, and nicotinic acid (Fig. 6) [18,21].

**Chemical constituents**

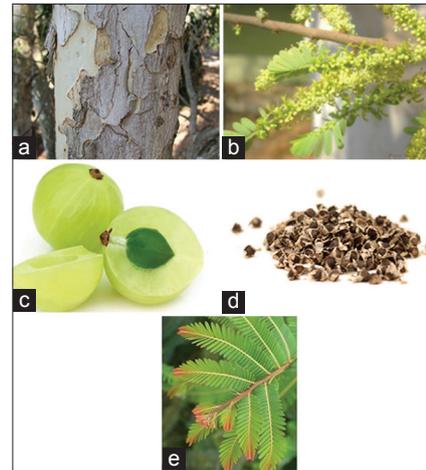
The fruits of *E. officinalis* are rich in tannins. The fruits have 28% of the total tannins distributed in the whole plant. The fruit contains two hydrolysable tannins emblicanin A and B, which have antioxidant properties, one on hydrolysis gives gallic acid, ellagic acid and glucose wherein the other gives ellagic acid and glucose. The fruit also contains phyllembin. Below table show chemical constituents of different parts of *E. officinalis* (Amla) plant (Table 10, Fig. 7) [22,22].

**Inorganic components present in *B. monnieri*, *C. rotundus*, *E. officinalis***

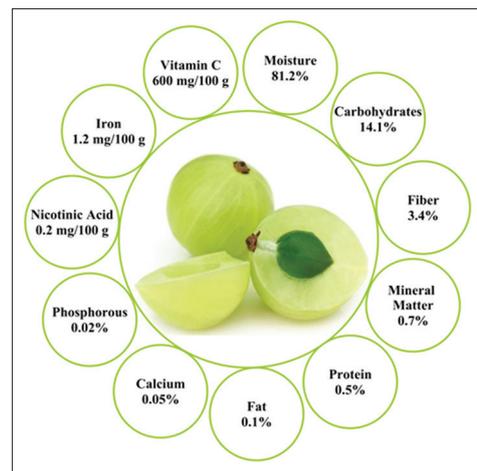
Prepared ash of the drugs material was added with 50% of v/v HCl. The filtrate was then subjected to analyze the inorganic elements. The results are tabulated in Table 11 [4,23,24].

**Phyto-constituent screening of *B. monnieri*, *C. rotundus*, *E. officinalis***

The phyto-constituents analysis revealed the presence of secondary metabolites such as tannins, saponins, alkaloids, flavonoid, steroids,



**Fig. 5: (a) Bark, (b) Flowers, (c) Fruits, (d) Seeds, (e) Leaves of *Emblica officinalis* (Amla)**



**Fig. 6 : Nutritional value of fruit of *Emblica officinalis* (Amla) (% or per 100g)**

**Table 8: Organoleptic characters of *E. officinalis* (Amla)**

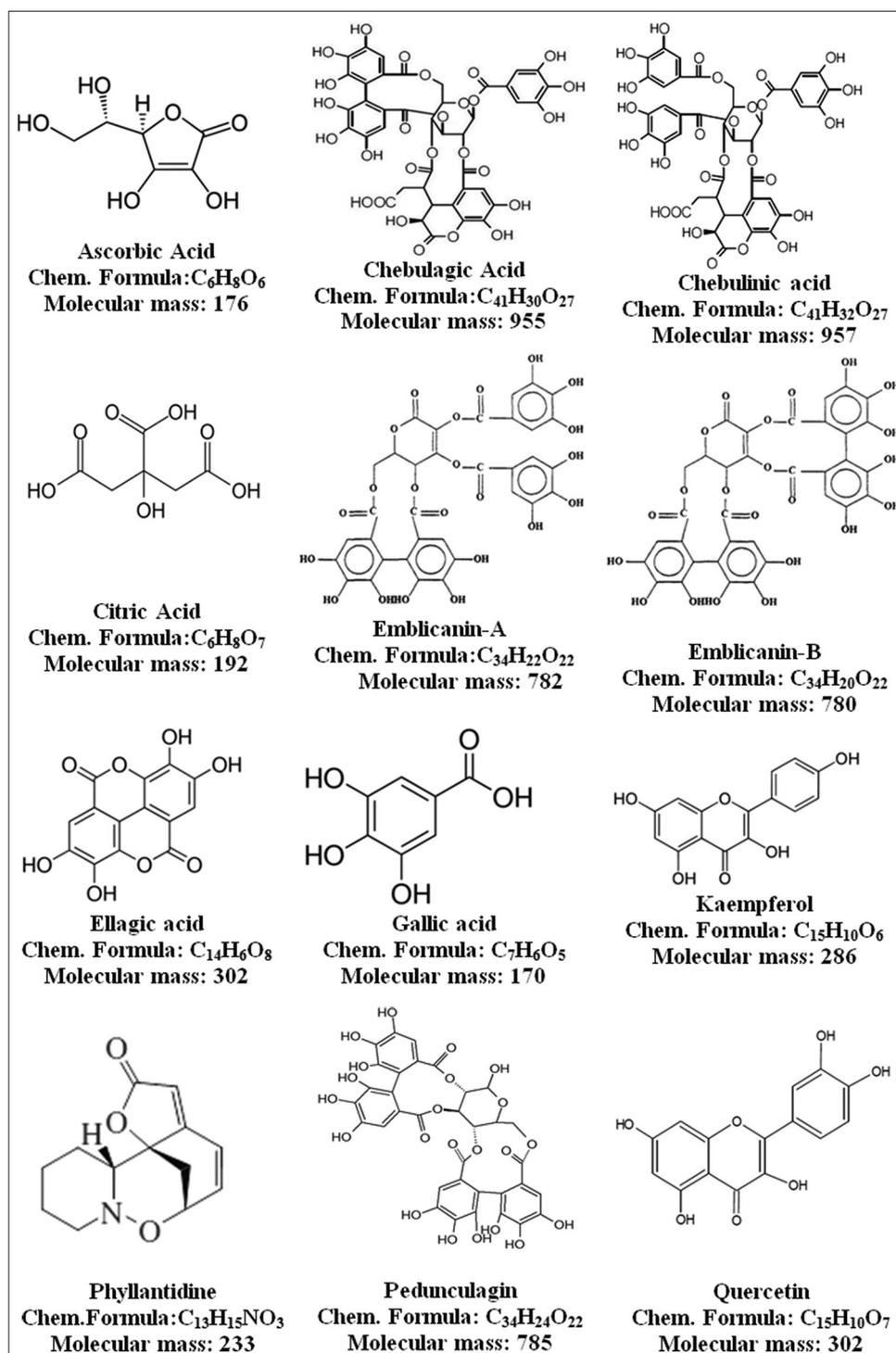
Serial number	Parameters	Observations
1	Colour	Yellowish green
2	Consistency	Hard
3	Odour	Aromatic
4	Taste	Sour

*E. officinalis: Emblica officinalis*

**Table 9: Physico-chemical properties of *E. officinalis* (Amla)**

Serial number	Parameters	Observations
1	Acid insoluble ash (w/w %)	1.90
2	Alcohol soluble extractive (w/w %)	15.5
3	Disintegration time	39 mins
4	Hardness test	6.9kg/m <sup>2</sup>
5	Loss on drying at 110°C (w/w %)	3.4
6	pH of 5% aqueous solution	3.37
7	Powder microscopic	15-20 micro
8	Total ash (w/w %)	5.33
9	Water soluble extractive (w/w %)	41.30

*E. officinalis: Emblica officinalis*

Fig. 7: Chemical constituents present in *Emblica officinalis* (Amla)

reducing sugar, carbohydrate, and many others in *B. monnieri*, *C. rotundus*, and *E. officinalis* shown in Table 12 [23-27].

#### Medicinal and traditional uses of *B. monnieri*, *C. rotundus*, *E. officinalis*

Its beneficiary uses in a number of diseases are enlisted in Table 13 [7,14,20,28,29-35].

#### CONCLUSION

*Bacopa monniera*, *E. officinalis* and *C. rotundus* are rich in pharmacological and therapeutics activities. The plants and their

extracts have been extensively investigated in several laboratories for their pharmacological and therapeutic effects.

Herbs and medicinal plants are rich in phytochemicals and they have been used for centuries in the treatment and prevention of various diseases. Some phytochemicals may be dangerous and some have no effect on human health. Thousands of phytochemicals have been isolated and characterized from plants, including fruits and vegetables.

With the global increase in the demand for plant-derived medicine as an alternative to synthetic medicine, there is a need to ensure the quality

Table 10: Chemical constituents present in various parts of *E. officinalis*

Part	Chemical constituents
Bark	Leucodelphinidin, Lupeol, $\beta$ -sitosterol, Tannins
Fruit	Alanine, arginine, ascorbic acid, aspartic acid, ash, $\beta$ -carotene, boron, calcium, carbohydrates, chebulagic acid, chebulaginic acid, chebulic acid, chebulinic acid, chloride, copper, corilagic acid, corilagin, cystine, d-fructose, d-glucose, ellagic acid, emblicol, emblicanin, ethyl gallate, fat, fibre, flavonoids, gallic acid, gallic acid ethyl ester, gibberellina-1, gibberellin-a-3, gibberellin-a-4, gibberellin-a-7, gibberellin-a-9, glucogallin, glucose, glutamic acid, glycine, glycosides, histidine, iron, isoleucine, leucine, lysine, magnesium, manganese, methionine, myo-inositol, myristic acid, niacin, nitrogen, pectin, phenylalanine, phosphorus, phyllantidine, phyllantine, phyllemblic acid, phyllemblin, phyllemblic acid, polysaccharide, potassium, proanthocyanidins, proline, protein, quercetin, riboflavin, rutin, selenium, serine, silica, sodium, starch, sucrose, sulfur, tannin, terchebin, thiamin, threonine, trigalloyl glucose, tryptophan, tyrosine, valine, water, zeatin, zeatin nucleotide, zeatin riboside, zinc
Leaf	Amlaic acid, astrogalin, ellagic acid, gallo-tanin, kaempferol, kaempferol-3-o-glucoside, phyllanthin, rutin, tannin
Pericarp	Ellagic acid, emblicol, gallic acid, phyllemblic acid
Root	Ellagic acid, lupeol
Seed	Linoleic acid, linolenic acid, myristic acid, oleic acid, palmitic acid, phosphatides, stearic acid, $\beta$ -sitosterol
Shoot	Chebulagic acid, $\beta$ -sitosterol, chibulinic acid, corilagin, ellagic acid, gallic acid, glucogallin, lupeol

*E. officinalis*: *Emblca officinalis*

Table 11: Inorganic components present in *B. monnieri*, *C. rotundus*, *E. officinalis*

Serial number	Parameters	Observations		
		<i>B. monnieri</i>	<i>C. rotundus</i>	<i>E. officinalis</i>
1	Calcium	+	+	+
2	Camphene	-	+	-
3	Carbonate	-	-	-
4	Chloride	+	-	+
5	Copaene	-	+	-
6	Copper	-	+	+
7	Iron	-	+	+
8	Magnesium	+	+	+
9	Manganese	-	+	+
10	Nitrate	-	-	-
11	Phosphorus	+	-	-
12	Potassium	-	+	+
13	Sodium	+	+	+
14	Sulphate	+	-	-
15	Zinc	-	+	+

+: Present, -: Absent, *E. officinalis*: *Emblca officinalis*, *C. rotundus*: *Cyperus rotundus*, *B. monnieri*: *Bacopa monnieri*

Table 12: Phyto-constituent Present in *B. monnieri*, *C. rotundus*, *E. officinalis*

Serial number	Phyto-constituent	Observations		
		<i>B. monnieri</i>	<i>C. rotundus</i>	<i>E. officinalis</i>
1	Alkaloids	+	+	+
2	Amino acids	-	-	-
3	Carbohydrates	+	+	+
4	Fixed Oil	-	-	-
5	Flavanoid	+	+	+
6	Glycoside	-	-	-
7	Phytosterols	-	+	-
8	Proteins	+	+	-
9	Reducing sugar	-	+	-
10	Saponins	+	+	-
11	Steroids	-	+	-
12	Tannins	+	+	+
13	Triterpenoids	+	+	-
14	Vitamin C	-	-	+
15	Volatile oil	-	+	-

+: Present, -: Absent, *E. officinalis*: *Emblca officinalis*, *C. rotundus*: *Cyperus rotundus*, *B. monnieri*: *Bacopa monnieri*

of the herbal drugs using modern analytical techniques, for therapeutic efficacy and safety.

Green plants synthesize and preserve a variety of biochemical products, many of which are extractable and used as chemical feed stocks or as

raw material for various scientific investigations. Many secondary metabolites of plant are commercially important and find use in a number of pharmaceutical compounds. The knowledge of medicinal plants used by the people of seems to be well known to its culture and tradition.

Table 13: Pharmacological and traditional applications of *B. monnieri*, *C. rotundus*, *E. officinalis*

<i>B. monnieri</i>	<i>C. rotundus</i>	<i>E. officinalis</i>
Adaptogenic activity	Abortifacient	Aging
Alzheimer's disease	Actogogue	Anemia
Analgesic effects	Alopecia (hair growth)	Anti-amnesiac
Anti-anxiety activity	Alterative	Anti-atherosclerotic
Anti-bacterial activity	Analgesic	Anti-bacterial activity
Anti-cancer activity	Anodyne	Anti-cancer activity
Anti-cholinesterase activity	Anthelmintic	Anti-epileptic
Anti-convulsant activity	Anti-bacterial	Anti-fungal activity
Anti-depressant activity	Anti-biotic	Anti-inflammatory
Anti-epileptic activity	Anti-dysenteric	Anti-microbial activity
Anti-inflammatory activity	Anti-emetic activity	Anti-nociceptive
Anti-leishmanial activity	Anti-fungal	Anti-oxidant activity
Anti-microbial activity	Anti-inflammatory	Anti-pyretic
Anti-oxidant activity	Anti-oxidant activity	Anti-ulcerogenic
Anti-parkinson	Anti-malarial	Anti-venom activity
Anti-spasmodic activity	Anti-convulsant activity	Anti-viral activity
Anti-tubercular activity	Anti-microbial	Aperient
Anti-ulcerogenic activity	Anti-parasitic	Astringent
Anxiolytic Activity	Anti-cancer activity	Blood sugar
Attention-deficit disorder	Anti-pruritic	Bronchitis
Blood pressure	Anti-pyretic	Cardioprotective
Bronchodilatory activity	Anti-spastic activity	Cholesterol
Cell stabilization activity	Anti-rheumatic	Cough
Endocrine effects	Anti-spasmodic	Cytoprotective
Free radical scavenging	Anti-tussive	Dental problems
Gastrointestinal	Aphrodisiac	Diabetes
Hair growth (Alopecia)	Aromatic	Diarrhea
Immunomodulatory activity	Astringent	Dosage of Vitamin C
Memory enhancer	Astringent	Dysentery
Neuroprotective role	Bactericide	Dyspepsia
Sedative	Carminative	Eye Care
Spasmolytic activity	Contraceptive	Febrifuge
Tranquilizing activity	Demulcent	Gonorrhea
Wound Healing activity	Deobstruent	Hair growth (alopecia)
	Diaphoretic	Healing dermal wounds
	Diuretic	Heart disorders
	Emmenagogue	Hepatoprotective
	Emollient	Hypotensive potential
	Febrifuge	Immunomodulatory
	Fumigant	Indigestion
	Fungistatic	Jaundice
	Hypoglycemic	Lipid lowering
	Hypotensive	Memory enhancing activity
	Gastroprotective activity	Menstrual problems
	Infectious diarrhea	Migraine
	Immunostimulant	Natural mouth freshner
	Improves circulation	Nephro protective
	Increases appetite	Nitric oxide radical
	Lipid lowering activity	Ophthalmic disorders
	Larvicidal activities	Pancreatitis
	Lithontripic	Piles
	Lowers blood pressure	Pruritus
	Nervine	Radiation protection
	Promotes memory	Respiratory problems
	Purifies the blood	Rheumatism
	Reduces breast tumors	Scabies and itch
	Sedative	Scurvy
	Stimulant	Skin sores and wound
	Stomachic	Spasmolytic
	Tonic	Triphala
	Tranquilizer	Urinary stone
	Vasodilator	Vaginal complaints
	Vermifuge	Vomiting
	Vulnerary	Weight management
	Wound healing activity	

*E. officinalis*: *Emblica officinalis*, *C. rotundus*: *Cyperus rotundus*, *B. monnieri*: *Bacopa monnieri*

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