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Is pineapple a fine apple?

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ABSTRACT

From the times immemorial, the whole pineapple plant including its leaves, barks, roots, ripe and unripe fruits and their juice is used as a traditional medicine. Pineapples have exceptional juiciness and a vibrant tropical flavor that balances the sweetness and tart. Due to its attractive sweet flavor, it is widely consumed as a fresh cut fruit, processed juice, canned fruit and as an ingredient in exotic foods. The fruit has a cylindrical shape, a scaly green/ brown/ yellow skin. It has a regal crown of spiny, blue-green leaves and fibrous yellow flesh, which has been shown to possess multifarious clinical activities. The prominent medicinal profile of pineapple includes anthelmintic, anti-diabetic, anti-inflammatory, anti-thyroid, anti-tumor, anti-viral, anti-oxidant, desmutagenic, diuretic and hypolipidemic properties. Phytochemically, the whole plant contains carbohydrates, alkaloids, terpenoids, essential oils, minerals, elements, vitamins and glycosides. The present review article is a humble attempt to enlighten the potential of this tasty and juicy gift of nature. It has a rich history of use as both, edible fruit as well as a traditional medicine in divergent ethno botanical practices throughout the tropical and subtropical world. The juicy and tasty fruit of pineapple is popular among children and youth for the delicious dishes derived from it.

Key words : *Ananas cosmosus*, Pineapple, Ananas, Bromelains

INTRODUCTION

Pineapple, a juicy and tasty fruit, belonging to family Bromeliaceae is scientifically known as *Ananas cosmosus*. It is a native of South America, Europe and is now grown in various parts of the world, including India. *Ananas cosmosus* includes two words: Ananas and cosmosus, where *Ananas* is modified from the original South American name for the plant, *nana*, meaning fragrance and *comosus* means long hairy. Pineapple is certainly a strange name for this common fruit that has no direct connections to pine or apple trees. The Spanish saw the fruit's resemblance to a pine cone, and first called it "Pine of the Indies". The English called it an apple because of its tasty nature. The name pineapple comes from the combination of the Spanish "pina" with the English "apple". Caribbean Indians placed pineapple crowns outside their entrance gates to their dwellings as symbols of friendship and hospitality. The word *Pineapple* in English was originally used to describe the reproductive organs of conifer trees (now termed pine cones).

History:

Pineapple was named after the resemblance to a pine cone, and the taste of the flesh being similar to an

apple. History states that it was discovered by Christopher Columbus on the island of Guadalupe in 1493, during his exploration of the Caribbean, who called it *piña de Indes*, or "pine of the Indies". He brought some of them back to Spain as a gift for Queen Isabella, who apparently was very fond of them. Guarani and Tope Indians (in South America) had already cultivated Pineapples for centuries, and they called them "nana" literally meaning "excellent fruit". In the Victorian Era, it became an icon of hospitality when sea sailing captains placed fresh pineapples on their gateposts to signify that the hosts were friendly and warm. George Washington declared pineapple as his favorite tropical fruit. Today, when we think of pineapples we think of Hawaii: In 1898, Hawaii became part of the United States, but due to high transportation costs pineapples did not provide lucrative business. In 1900, James Drummond Dole went to Hawaii with a thousand dollars, degrees in business and agriculture, and a dream of growing and canning pineapples. In 1901, he founded the Hawaiian Pineapple Co. and began canning the pineapple in 1903, making it easily accessible worldwide. Production costs were still high though, and remained so until an ingenious engineer, Henry Ginaca, invented a machine in 1911 that could remove the outer shell, inner core and both ends of

Botanical classification			
Domain	Eukaryota	Superorder	Bromelianaes
Kingdom	Viridiplantae	Order	Bromeliales
Subkingdom	Tracheobionta	Family	Bromeliaceae
Phylum	Pteridofitae	Subfamily	Bromelioideae
Subphylum	Euphyllophytina	Genus	Ananas
Infraphylum	Radiatopses	Specific epithet	cosmosus
Class	Lilopsida	Tribe	Dendrobieae
Subclass	Zingiberidae	Cultivar	Cayena lisa
Division	Magnoliophyta	Botanical name	<i>Ananas cosmosus</i>

Different species of pineapple	
<i>Ananas cosmosus</i>	<i>Ananas macrodontess</i>
<i>Ananas ananas</i>	<i>Ananas parguazensis</i>
<i>Ananas ananassoides</i>	<i>Ananas sativus (Pinya)</i>
<i>Ananas bracteatus</i>	<i>Bromelia ananas (Pangdan)</i>
<i>Ananas erectifolius</i>	<i>Bromelia cosmosa (Apagdan)</i>

Synonyms of <i>Ananas cosmosus</i> in Indian languages		
Language	Region	Names
Hindi	Haryana, Delhi	Ananas
Assamese	Assam	Anaras
Tamil	Tamilnadu	Annasi
Kannada	Karnataka	Anasahannu
Sanskrit	India	Anamnasam, Bahunetrphalam
Telugu	Andhra Pradesh	Annasapandu
Bengali	West Bengal	Ananash, Anaras
Gujarati	Gujarat	Ananas
Punjabi	Punjab	Pineapple
Malyalam	Kerala	Kaitaccakka, Kappaccakka, Ananas
Marathi	Maharashtra	Ananas

100 pineapples in less than a minute. The machine is still used today and is known as the "Ginaca machine". By 1921 the Dole Hawaiian pineapple Company was a flourishing business, making pineapple Hawaii's largest crop and industry. Nowadays Hawaii produces only ten per cent of the world's pineapples and many other countries cultivate them all over the world, including: Mexico, Honduras, Dominican Republic, Philippines, Thailand, Costa Rica, China, and Asia.

Geographical distribution:

The cultivation of pineapple is confined to high rainfall and humid coastal region in the peninsular India and hilly areas of North-Eastern region. It can also be grown commercially in the interior plains with medium rainfall

Vernacular names of <i>Ananas cosmosus</i> in different countries	
Languages	Names
Brazil	Abacaxi, Panacous, Pita, Pinha
Burma	Na NaqThi
China	Feng Li
Cook Islands	Ara kai
Dominica	Cockerell, Idiaua, Kuraua
Fiji	Andras, Painap, Painappuru
France Guiana	Ananas
Gabon	Ananas, Iguwu
Germany	Ananas
Guadeloupe	Ananassa
Guatemala	Pina, Ananas Edule
Guyana	Pine, Pineapple
India	Ananas, Pineapple
Indonesia	Nanas, Pineapple
Iran	Pineapple
Italy	Aainunnas
Japan	Ananasso
Malaysia	Nanas, Nenas, Pineapple
Mexico	Yeiawa
Nepal	Matzatli
Nicaragua	Bhaikatacher
Peru	Anana, Lagarto pina, Pina
Puerto Rico	Pina comun, Pina
Sri Lanka	Nanna-ti
Taiwan	Pineapple
Tahiti	Pineapple
Thailand	Kateh, Pineapple
Trinidad	Pineapple, Sapparot
Turkey	Pineapple
USA	Festa
	Ananas, Iaiua, Pineapple, Zanana

and supplementary protective irrigations. At present, it is grown commercially in almost all the states of India,

Mexico, Honduras, Australia, Philippines, Thailand, Costa Rica, China and Asia.

Botanical description:

Plant:

Pineapples are rosette-forming, herbaceous monocots, 2-4 ft tall and 3-4 ft wide. Stems are short (12"), and inconspicuous in the center of the rosette of long (20-72"), linear leaves. The leaves have spines at tips and margins being spirally arranged on stems and have axillary



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buds at their base that can produce lateral shoots called suckers.

Fruit:

The fruit type is a multiple of berries, formed from the fusion of adjacent flower ovaries on the spike as they mature. The core is fleshy, often fibrous and unpalatable. The fruit is covered with a waxy, leathery rind, made up of hexagonal "eyes", arranged spirally, which denote the position of individual flowers.



Flowers:

Flowers are small (1/2 - 1"), purple-red, subtended by a single yellow, green or red bract, borne laterally on the rachis of a spike of 100-200 individuals. The apex of inflorescence is vegetative, becoming the "crown" on the fruit.

Pollination:

Pineapple exhibits gametophytic incompatibility, where the pollen germinates on the stigma, but fails to grow through the style and effect fertilization. Seedless fruits are set parthenocarpically. If flowers are cross-pollinated, a few small, brown seeds may be found just beneath the peel of the fruit. Humming birds are the natural pollinators.

Traditional uses of pineapple :

From the times immemorial, the whole pineapple plant including its leaves, barks, roots, ripe and unripe fruits and their juices is used as a traditional medicine.

- The fruits are sweet, diuretic, carminative, sudorific, styptic, lithontriptic, antiscorbutic, febrifuge and brain tonic.

- The pineapples are used as a blood purifier, to aid digestion, for gastro-intestinal disorders, diseases of the larynx and pharynx, as a mild antiseptic, a stimulant taken orally for weight loss, as a stomachic and to treat diabetes.

- They are useful in vitiated conditions of strangury, flatulence, colic, hyperacidity, jaundice, renal and vesical calculi, scabies, pruritus.

- The flowers are used by female adults as an emmenagogue.

- Decoction of fresh fruit is taken orally as an abortifacient.

- Hot water extracts of dried flowers is taken orally as an anthelmintic, leaf as an emmenagogue and abortifacient, dried root as an abortifacient and diuretic and dried bark for the treatment of arthritis.

- The leaf juice is used to treat venereal diseases, as an anthelmintic and as a purgative

- Pineapple is an excellent source of the trace mineral manganese, which is an essential cofactor in a number of enzymes important in energy production and antioxidant defenses.

In addition to manganese, pineapple is a good source of thiamin (vitamin B) that acts as a cofactor in enzymatic reactions central to energy production.

Pharmacological activities:

Anti-diabetic activity:

Ananas cosmosus leaves possess potential for the

Cultivars of pineapple		
Variety	Characteristics	Country
Kew	Big-sized (1.5-2.5kg), oblong and tapering slightly towards the crown, shallow eyes becomes yellow when ripe, flesh is light yellow, almost fibreless and very juicy	India (West Bengal)
Giant Kew	Synonymous to Kew except the size of plant and fruit which is larger than Kew as the name signifies	India (West Bengal)
Queen	Rich yellow color fruits (0.9-1.3kg), golden-yellow flesh less juicy than Kew, crisp texture, pleasant flavor, eyes small and deep, brownish-red leaves, shorter and spiny.	India (Tripura, Assam, Meghalya), Germany
Mauritius	Medium sized, deep yellow and red color fruits, oblong, fibrous and medium sweet compared with red ones	India(Kerala) , Malaysia, Brazil
Jaldhup	Sweetness well-blended with acidity, characteristic alcoholic flavoured easily distinguished from other fruits of the Queen group	India(Assam)
Cayena lisa	Pale yellow pulp color, clear yellow color juice with high sugar content	Sri Lanka, Germany, Malaysia, Hawaii,
Spanish	Average weight, 1 kg, golden yellow pulp color, low acid and sugar content	Spain, Singapore
Red Spanish	Average weight of 1.2 to 2 kg. medium sugar content with low acidity	Spain, Singapore, Germany
Green Selacia	Green flower leaves and yellow suckers, retains the main qualities of the Spanish	China, Japan
MD 2	Average weight of 1.3 to 2.5 kg, an intense orange to yellow-orange color, high sugar content, sweet, compact and fibrous fruits	USA, Japan, Europe
Sugarloaf	Juicy, watery, light, sweet taste, tall, narrow and has very smooth, bright green leaves, yellowish-white flesh has a mild flavour.	United States

development of a plant medicine for diabetes and its complications. Ethanolic extract of *Ananas comosus* leaves shows anti-diabetic activity by significantly decreasing blood glucose, increasing HDL, and lowering lipid peroxidation productions of blood, brain, liver and kidneys (Xie *et al.*, 2005). Ethanolic extract of *Ananas cosmosus* inhibits HMGC_oA reductase activity by 20-49% *in vitro* suggesting *Ananas cosmosus* as a potential natural product for the treatment of hyperlipidemia. Ethanolic extracts of *Ananas comosus* L. leaves (AC) enriched with phenols have hypoglycemic activity in diabetic rats. Diabetic Wistar rats showed increased sensitivity to exogenous insulin when they were treated with ethanolic extract of *Ananas cosmosus* leaves (Xie *et al.*, 2006).

Anti-oxidant activity:

Pineapple decreased macrophage oxidative stress, plasma carbonyl content and enhanced the free-radical scavenging activity of the hepatic enzymes catalase, super oxide dismutase and peroxidase (Xie *et al.*, 2005). Pineapple is a rich source of Vitamin C, which is the body's primary water-soluble antioxidant, defending all aqueous areas of the body against free radicals that attack and damage normal cells (Mhatre *et al.*, 2009).

Anti-inflammatory activity:

Pineapple inhibits both cyclooxygenase and

lipoxygenase enzymes, reduce plasmakinin levels which are responsible for inflammation. Bromelain, a clinically used pineapple extract, possesses anti-inflammatory activity (Eric *et al.*, 2005).

Antitumor activity:

Bromelain, a pharmacologically active compound, present in stems and immature fruits of pineapples, induced apoptosis-related proteins along with inhibition of nuclear factor-kappa B (NF- κ B)-driven Cox-2 expression by blocking the mitogen-activated protein kinase (MAPK) and Akt/protein kinase B signaling in 7,12-dimethylbenz (a)anthracene (DMBA)-initiated and 12-O-tetradecanoylphorbol-13-acetate (TPA)-induced mouse skin tumors, which may account for its anti-tumor activity (Kalra *et al.*, 2008). Pineapple interferes with the growth of malignant cells and tumors. Bromelain, a cysteine proteinase from the pineapple stem, showed an anti-tumor effect on mice, superior to that of 5-FU with an antimetastatic action independent of the primary antitumor effect.

Immunomodulatory activity:

Mice treated with bromelain increased β -cells and reduced interleukin-2 indicating enhanced antibody response. Thus, pineapple appears to be an immune booster agent (Engwerda *et al.*, 2001).

Phytoconstituents of Pineapple

Sr. No.	Phytoconstituents	Part	Reference
1	Acids Acetic acid, Ananas cosmosus acid, Aspartic acid, Caffeic acid, Chlorogenic acid, citric acid, Formic acid, Glutamic acid, Myristic acid, p- coumaric acid, Pipecolic acid, Sinapic acid	Fruit juice, fruits, Leaves	Yeoh <i>et al.</i> ,1986
2	Anthocyanins Antheraxanthin (cis), Antheraxanthin, Auroxanthin, Cis violaxanthin, Cryptoxanthin,Cyanidin-3,3',5,0-beta-D-di and triglucoside, Di cis violaxanthin, Flavoxanthin, Luteoxanthin, Mutatoxanthin, Neo chrome, Neoxanthin, Neurosporine, Trollixanthin	Fruit juice and Leaves	Saito and Harborne, 1983
3	Triterpenoids α -tocopherol, Campasterol, α -carotene, β -carotene, Hydroxy- α -carotene, Zeta carotene	Fruits and Leaves	Mannan and Ahmad, 1966
4	Essential oils α -carotene, α -copaene, α -terpineol, Campestenol, Camphor, Delta cadinene, Gamma octalactone,Hydroxy alpha carotene,Linalool oxide, linalool, Methanol,Myricyl alcohol,Xylitol	Fruits, fruit juice	Berger <i>et al.</i> , 1983
6	Sugars Fructose, Glucose, Sucrose	Fruits and fruit juice	Boland <i>et al.</i> , 1972
7	Amino acids Alanine, Arginine, Glycine, Histidine, Leucine, Metionine, Phenylalanine, Proline, Serine, Threonine, Tryptophan, Tyrosine, Valine	Fruits, Leaves	Yeoh <i>et al.</i> , 1986
8	Aliphatic alcohols 2-Methyl pentan-2-ol, 3-Methyl pentan-3-ol, Butanol, Ethanol, Hexan-1-ol, Methanol, Menth-1-en-4-ol, Pentan-1-ol	Fruits	Naf Muller and Willhalm, 1971
9	Esters Acetic acid methyl thio-methyl ester, Acrylic acid methyl and ethyl ester, Allyl hexanoate, Alpha methyl butyric acid methyl ester, Beta-acetoxy caproic acid ethyl ester, Beta-acetoxy octanoic acid methyl ester, Butyl acetate, Calcium oxalate, Decanoic acid ethyl ester, Ethyl acetate, Ethyl formate, Ethyl lactate , Heptanoic acid methyl ester, Methyl acetate, Methyl formate, Methyl iso-valerate,N-ethyl and methyl caproate, Octanoic acid methyl esters	Fruits	Naf Muller and Willhalm, 1971
10	Carotenes α -carotene, β -carotene, Hydroxy- α -carotene, Zeta carotene	Fruit juice	Morgan, 1966
11	Hydrocarbons and oxygenated derivatives Benzopyrene, Alpha copaene, Camphor, Ergesterol,Gamma eudesmol, Gamma gurjunene, Myricyl alcohol, Xylitol	Fruits, Leaves and Fruit juice	Berger <i>et al.</i> , 1983

Hepato-protective activity:

Effect of pineapple (*Ananas comosus*) on liver and kidney detoxication was studied in Wistar rats. Rats were treated with paracetamol at the dose of 2 g/kg of body weight per day for 6 weeks and then by *Ananas comosus* extract (0.06 - 0.12 ml/kg body weight). Administration of paracetamol induced hepatomegaly with a centrolobular necrosis and an increase in kidney weight. Treatment with *Ananas comosus* extract induced a reduction of hepatic lesions but no effect on kidney. These data suggest that *Ananas comosus* extract treatment reduces hepatotoxicity of paracetamol in Wistar rats (Dougnon *et al.*, 2009).

Platelet aggregation activity:

Pineapple reduced serum fibrinogen level, prolonged the prothrombin time and activated partial thromboplastin time attributing to enhanced conversion of plasminogen to plasmin, which limits the spread of coagulation process by degrading fibrin (Bhattacharyya *et al.*, 2008). The bromelains are a group of closely related proteolytic enzymes obtained from the stem of the pineapple plant (Lotz-Winter, 1990). They exhibit both fibrinogenolytic and fibrinolytic properties but are severalfold more specific for fibrin than fibrinogen. In rats, intravenous treatment with 1–30mg/kg bromelain caused dose-dependent

Important chemical constituents of <i>Ananas cosmosus</i>			
Sr. No.	Phytoconstituents	Plant part	Reference
1.	Phytosterol β-Sitosterol, Campesterol	Leaves	Pakrashi <i>et al.</i> , 1975
2.	Essential oils α-carotene, α-copaene, α-terpineol, Campestenol, Camphor, Delta cadinene, Gamma octalactone, Hydroxy alpha carotene, Linalool oxide, linalool, Methanol, Myricyl alcohol, Xylitol	Fruits, fruit juice	Berger <i>et al.</i> , 1983
3.	Glycosides Cyanidin-3,3',5,0-beta-D-triglucoside, Cyanidin-3,5,0-beta-D-diglucoside, Peonidin-3,5,0-beta-D-glucoside	Leaves	Saito and Harborne, 1983
4.	Alkaloids 6-hydroxy-1-methyl-1,2,3,4-tetrahydro-δ-Carboline	Fruits and fruit juice	Heraiz and Galesteo, 2003
5.	Neurochemicals Serotonin, Adrenaline, Noradrenaline, Dopamine	Fruits	Feldman Lee, 1985
6.	Enzymes Bromelains, Bromelin A and Bromelin B	Fruits and Stem	Wyk <i>et al.</i> , 2009

reductions of plasma fibrinogen. Maximal fibrinogen depletion (85%) was observed within 1–2 h of treatment. Bromelain given orally to rabbits at doses of 5–200 mg/kg significantly increased prothrombin time (Smith *et al.*, 1962).

Diuretic activity:

Study of the root extracts of *Ananas comosus* in rats significantly increased urine output (Sripanidkulchai *et al.*, 2001).

Abortifacient effect:

Ethanol (95%) extract of unripe pineapple fruit at a dose of 200 mg/kg and water extract at a dose of 100 mg/kg showed abortifacient effect, when administered orally to rats (Wildemann *et al.*, 1909).

Anthelmintic activity:

Cysteine proteinases, from pineapple fruits have high proteolytic activities that are known to digest nematode infections in both humans and animals exhibiting anthelmintic activity. Anthelmintic activity of the aqueous and alcoholic extracts of *Ananas cosmosus* has showed potent activity against *Taenia canina* (Gillian *et al.*, 2004).

Cosmetic properties :

Pineapple fruit has some active principles with important effect on skin - sugars and α-hydroxy-acids (AHA) as well as enzymes. These active principles are responsible for its moisturizing and anti-ageing action. Pineapple also has antifungal and purifying effect on the

skin (Taira *et al.*, 2005).

Dishes containing pineapple

- Real Juice
- Pastries
- Fruit salad
- Ice-cream
- Jellies
- Jams
- Cake
- Snacks
- Raita
- Flavors
- Vinegar
- Chunks
- Canned pineapple
- Dehydrated pineapple
- Food supplements

Cake:

- Each pineapple plant only produces just one pineapple per year
- Unripe pineapples can actually be quite poisonous. Eating them cause serious throat irritation and a strong laxative effect
- Pineapples grow slowly, and can take up to two years to reach full size, but if they are left to their own devices they can reach up to 9kg (20lbs)
- Reversing the unripe pineapple upside down, while it is on the plant, speeds up the ripening process
- Traditionally, pineapple juice was used as a diuretic

Nutritional factors	
Elements	Amount
Total Calories	48 kcal
Total Fat	0.11 g
Saturated Fatty Acids	0 g
Monounsaturated Fatty Acids	0.01 g
Polyunsaturated Fatty Acids	0.04 g
Cholesterol	0 mg
Sodium	1 mg
Total Carbohydrates	12.63 g
Dietary Fiber	1.39 g
Sugars	9.26 g
Protein	0.54 g
Water	86.45 g
Vitamin C	36.2 mg
Riboflavin	0.03 mg
Niacin	0.48 mg
Pantothenic Acid	0.2 mg
Vitamin B6	0.1 mg
Vitamin B12	0 mcg
Folate	15 mcg
Vitamin A	56 IU
Vitamin E	0.01 mg
Vitamin K	0.69 µg
Folic Acid	0 mcg
Calcium	13 mg
Iron	0.28 mg
Magnesium	12 mg
Phosphorus	8 mg
Potassium	115 mg
Sodium	1 mg
Zinc	0.1 mg
Copper	0.09 mg
Manganese	1.17 mg
Selenium	0.1 mcg

and to induce labor

- When you cut a pineapple, you normally chuck the skin, core and throw in the dustbin. These bits are used for making alcohol, vinegar and animal feed

- The bromelain enzyme in pineapples breaks down proteins. This means that you can use pineapple or pineapple juice as a meat tenderizer

- The same Bromelain breaks down the gelatin into jellies. You can stop this from happening by boiling the chunks of pineapple in water for a few minutes

- Pineapple juice, when mixed with sand is very good for cleaning boat decks and machete blades

- Every time, when you eat a copious amount of pineapple, the roof of your mouth becomes itchy and sore. Bromelain induces a prickly sensation in the mouth,

when consumed.

Concluding remarks:

Traditionally, pineapple juice was used as a diuretic and to induce labor. The juicy and tasty fruit of pineapple is popular among children and youth for the delicious dishes derived from pineapple such as real juice, pineapple pastry, pineapple jam and pineapple cake. Pineapple is certainly a strange name for this common fruit that has no direct connections to pine or apple trees. A keen interest in therapeutic properties of pineapple has led to numerous *in vitro* and *in vivo* animal and clinical studies. Anticarcinogenic, anti-hypertensive, hypolipidemic, hypoglycemic and anti-inflammatory properties of pineapple reveal its therapeutic potential in the management of several types of cancer, cardiovascular diseases and diabetes.

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