



**A REVIEW OF PERENNIAL HERB ANANAS COMOSUS AND ITS MULTIPLE USES IN
FOOD, DRUGS AND COSMETICS**

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ABSTRACT

Ananas comosus is one of the most wonderful fruit with nutritional and health benefits belonging to the family Bromeliaceae. Pineapples are rich in bromelain and vitamin C. Now-a-days consumers are moving more towards natural cosmetic products due to which various herbal ingredients are added in cosmetic formulations. It is traditionally used as a dynamic fruit for its multiple health benefits from relieving bowel to control over nausea, keeping the intestines and kidneys clean and so on. Apart from being a popular fruit for the consumption, its richness in vitamin C and bromelain prompts its uses in cosmetics that have antioxidant and antibacterial properties beneficial for the skin and oral care. Not only the fresh fruit but also its waste which otherwise is thrown is found to be helpful in production of ethanol, extraction of bromelain and has excellent antioxidant properties. Hence this article focuses on exploring fascinating benefits of the pineapple along with its waste in cosmetic industry.

KEYWORDS: Ananas comosus, antimicrobial, antioxidant, benefits, cosmetic uses, pineapple waste.

INTRODUCTION^[1,2]

Pineapple: Ananas comosus is cultivated for its fruit and for fibre in many parts of the world including India. Pineapple is a wonderful tropical fruit known for its exceptional juiciness, vibrant tropical flavour and immense health benefits and it contains calcium, potassium and vitamin C. Vitamin C is the body's primary water-soluble antioxidant that attack and damage normal cells against free radicals. It is a natural Anti-inflammatory fruit. Fresh pineapples are rich in bromelain which demonstrates significant anti-inflammatory effects.

1. Biological source: Ananas comosus is a perennial herb belonging to the family Bromeliaceae.
2. Geographical source: Pineapple is native to tropical America and then introduced into India and is extensively cultivated in Meghalaya, Assam, Tripura and West Bengal in eastern India; parts of Uttar Pradesh; Andhra Pradesh and Tamil Nadu in peninsular India; Maharashtra, Goa, Karnataka and Kerala on the West coast, and Andamans are the major states which are into pineapple cultivation.

BOTANICAL DESCRIPTION OF ANANAS COMOSUS

a) Synonyms^[1]

Bengali	Anarash
Gujarati and Marathi	Ananas
Hindi	Anannas
Kannada	Ananasahannu
Malayalam	Kaitha chakka, kazhudachakka
Tamil	Anashappazham
Telugu	Anaasachettu (plant), anaasapandu (fruit)

b) Taxonomy^[3,4,5]

Kingdom: Plantae
Subkingdom: Tracheobionta
Superdivision: Spermatophyta
Division: Magnoliophyta
Class: Liliopsida
Order: Bromeliales
Family: Bromeliaceae
Subfamily: Pitcarnioideae, Tillandsioideae, Bromelioideae
Genus: Ananas
Species: A. comosus

c) Morphology and description^[1]

Pineapple is a perennial herb with the height 90-100cm. It has two types of roots, one occurring around the stem

in a hemispherical mass with some arising from the axils; and the second type consist of slender rots which penetrate the soil up to 1.2m. Stems are stout and thick, 20-50cm high, 7-11cm thick, and are hidden by leaves. Leaves are mostly densely tufted and rigid, sword-shaped. When unripe the shell is dark green and dark orange-yellow with mottling when ripe.

CULTIVATION OF ANANAS COMOSUS^[6]

The crop is generally retained for 3 crops over 4-5 years in India. Pineapple planting is best done during the early rains, under rain-fed conditions. An optimum rainfall of 100-150cm well distributed through the year is ideal for raising the crop commercially under rain-fed conditions. It is well developed on many types of the soils, ranging

from sandy to clayey and even gravelly soils. Depending on the soil the field must be prepared thoroughly by ploughing, cross ploughing, laddering, etc., or by forking or hand-hoeing as pineapple is a perennial and delicate crop. This crop takes 15-20 months or more for the fruits to mature after planting. The yield may vary with cultivar, climate, number of plants per hectare and the practices adopted.

INDIAN HISTORY^[7]

Ananas comosus was introduced in India in 1548 on the East coast, and rapidly spread. It thrives in the littoral tract and inundated areas but still it has attained its greater perfection in the hinterland.

VARIETIES OF PINEAPPLE^[8]

S.No	Name	General description
1.	Smooth Cayenne	Ovoid medium-sized fruit of 1.5 to 2.5 kg, yellow from base to top when ripens, pale-yellow to yellow colour at maturity, juicy, average acid range between 0.5 and 1.0%. Usually cultivated in Hawaii, Philippines, Australia, South Africa, Rico, Cuba, Mexico.
2.	Mauritius	Suggested for commercial cultivation for table purposes and distant marketing. Better fruit and keeping quality and transportability due to its shorter duration.
3.	Vazhakulam pineapple	Also known as 'Kannara' which belongs to Queen Cultivar (Mauritius), average weight of 1300-1600gms, slightly conical shape, pleasant aroma, fruit flesh is yellow and crisp, has sweet juice with 14-16 o brix, 0.50 – 0.70% acidity. Good source of vitamins, minerals, carotene and energy.
4.	Amritha	Spiny leaves, duration of 13-15 months. Cylindrical in shape and slightly tapering from near base, 1.5-2.0kg, crown of 80-100g, when unripe green in colour and uniformly yellow when ripe, fruit has mild external aroma and skin 6mm thick, crisp, non-fibrous. Good taste with low acidity and high total soluble salts.
5.	Ornamental and Baby pineapple	Popular among landscapers and gardeners, have extremely beautiful multicolour foliage and flower heads.



Fig. 1: Smooth Cayenne.



Fig. 2: Mauritius.



Fig. 3: Amritha.



Fig. 4: Ornamental and Baby pineapple.

EXTRACTION TECHNIQUES1] Maceration^[9,10]

The fresh fruit of pineapple is cut into cubes and are dried in the shade. Then they are crushed to a fine powder. For maceration in a glass beaker 10gm of this powder is soaked in 100ml of ethanol (85%) and then keep on a rotary shaker for 72 hours. Using Whatman filter paper No.1. the filtration of the is carried out. Filtrated ethanolic extract is dried at room temperature for alcohol evaporation and then the dried extract is stored in sterile air-tight bottle at -20°C for future use.

2] Extraction and purification of bromelain^[11,12]

Extraction is carried out by collecting the parts of the fresh pineapple stem and wash them with 0.1% hydrogen peroxide solution, peel them off and cut into small pieces and the weigh them. Extract the juice from the part of the fresh pineapple stem in the presence of the sodium acetate buffer by homogenization and expose it to filtration. Then collect the 500ml of filtrate and preserve using benzoic acid or sodium benzoate at a concentration of 1gm/kg of stem. The filtrated collected is called as crude extract and can be used as source of stem bromelain.

Take the freshly ripe fruit of pineapple, clean and cut them into small pieces. Then weigh them collect into a beaker, extract using a homogenizer and filter it. To the filtered mass add sodium benzoate as a preservative at a concentration of 0.2% g for each for 100ml of filtrate. Then the filtrate can be used as a source of fruit bromelain and labelled as fruit crude extract.

Purification is done by using centrifuge. Centrifuge the crude lysate (SCL and FCL) for 10 minutes at 2000 rpm,

10 minutes at 4000rpm and 15 minutes at 4000 rpm one after the another without interruption. Collect the supernatants from the centrifugation and label as 'Stem Crude Extract' (SCE) from stem and 'Fruit Crude Extract' (FCE) from fruit.

In a ion exchange chromatography column prepare a bed of 15cm thickness made of diethylaminoethyl (DEAE) cellulose and equilibrated with 0.5 M sodium phosphate buffer solution of pH 8.0. Then elute this by buffer 1 (pH: 8.1) that contains 25mM Tris HCL and 25 mM NaCl. Without disturbing the DEAE cellulose bed pour the enzyme extract onto the column from the sides. At a flow rate of 6 drops per minutes elute the sample using the first eluting buffer 1 and collect the elute in 5ml capacity plain container. Carry out the same process using solution buffer 2, 3, 4, 5, and 6 which contains 50 mM, 75 mM, 100 mM, 125 mM, 150 mM NaCl (pH 8.1). Pour the enzyme samples onto the column again with enzyme being eluted using eluting buffer 2 (10ml of 25 mM Tris HCl and 50 mM NaCl), pH: 8.1. Elution process is continued using buffers 3, 4, 5 and 6 containing 75 mM, 100 mM, 125 mM and 150 mM of NaCl. Carry out the assay for 5ml each of all the ion-exchange elutes for enzyme activities and total protein concentration determined by Bradford method.

3] Ultrasound extraction^[13]

Ultrasound-assisted extraction method is used to obtain pericarp, peel and crown leaves and pulp extracts with absolute, 80% and 60% methanol in 1:10 ratio. In the ultrasound bath extract the plant material for 40 minutes. The liquid obtained after the filtration is dried under vacuum apparatus. Keep all the extracts in well-sealed glass bottles at 4°C

CHEMICAL COMPOSITION AND ITS CONCENTRATION OF ANANAS COMOSUS^[14]

S.No	CHEMICAL COMPOSITION	CONCENTRATION
1.	Moisture	87.8%
2.	Protein	0.4%
3.	Fat	0.1%
4.	Fibre	0.5%
5.	Carbohydrates	10.8%
6.	Calcium	20.0%
7.	Phosphorus	9.0%
8.	Iron	1.2%
9.	Thiamine	0.2%
10.	Riboflavin	0.12%
11.	Niacin	0.1%
12.	Vitamin C	39.0%
13.	Magnesium	20.0%
14.	Sodium	34.7%
15.	Potassium	37.0%
16.	Copper	0.36%
17.	Sulphur	20.0%

ANTIMICROBIAL ACTIVITY^[9]

Mehdi Goudarzi et al, has studied the antibacterial activity of pineapple peel extract and pineapple fruit extract against facultative anaerobic and gram positive cocci including *S. sanguis* and *S. mutans*. The strongest antibacterial activity was revealed by pineapple peel extract with highest inhibition zones (30mm and 28mm) and lowest concentration i.e., 1.56mg/L and 6.25mg/mL was shown against *S. sanguis* and *S. mutans*. Moderate antibacterial efficacy was shown by pineapple fruit extract against *S. sanguis* and *S. mutans* with inhibition zones of 28mm and 20mm, MICs of 12.5 mg/mL and 25 mg/mL. Pineapple fruit extract showed the lowest activity (7.0 mm) against *S. mutans* but highest activity against *S. sanguis* with inhibition zone of 28 mm. Pineapple peel extract showed lowest MIC (1.56 mg/mL) and MBC (3.12 mg/mL) against *S. sanguis*.

EFFECTIVE CONCENTRATION^[9]

As reported by Mehdi Goudarzi et al, the MIC (Minimum inhibitory concentration) and MBC (Minimum bactericidal concentration) of pineapple was found to be 25mg/mL and 100 for *Streptococcus mutans* and 12.5mg/mL and 25 for *Streptococcus sanguis*. The MIC and MBC of pineapple peel was 6.26mg/mL and 12.5 for *Streptococcus mutans* and 1.56mg/mL and 3.12 for *Streptococcus sanguis*.

ANTIOXIDANT ACTIVITY^[13,15,16,20]

Antioxidant capacity of the fruit is usually due to the high levels of L-ascorbic acid but in the case of antioxidant activity synergism of many active compounds play a important role which means that many substances present themselves act as antioxidants and the substances which do not have antioxidant properties can increase the antioxidant power of L-ascorbic acid. Cuendet et al. described a method to measure the antioxidant ability of pineapple extracts which includes the change in colour of 1,1-diphenyl-2-picrylhydrazyl radical (DPPH) from purple to yellow of ethanol solution. The antioxidant capacity of pineapple was compared with one of the high antioxidant substance called ascorbic acid. Few phenols was detected in pulp extracted by 80% methanol viz, 22.99 ± 2.36 mg GAE / g with IC_{50} value 8.18 ± 0.66 mg/ mlmL. The lowest quantity of phenols was found in pineapple juice viz, 0.79 ± 0.07 mg GAE /g with IC_{50} value 88.00 ± 2.09 mg/ mlmL.

COSMETIC USES**a) SKIN CARE**

As we know pineapple is rich in vitamin C which has effective antioxidant properties it can be used in anti-aging and anti-wrinkle creams. The pineapple extract can also be incorporated in sunscreens and skin whitening creams due to its antioxidant properties.

b) ORAL CARE

As discussed, pineapple fruit extract and pineapple peel extract has antibacterial activity against oral pathogenic

bacteria i.e., *Streptococcus mutans* and *streptococcus sanguis* which causes tooth decay, so it can be incorporated in toothpastes as well as mouthwashes as a natural antibacterial agent since the antibacterial agents which are often used in products may have negative side effects like change in taste, discolouration of teeth and tongue or some sensation towards the oral health.

MEDICINAL AND THERAPEUTIC USES^[18]

As pineapple is rich in fibre it makes bowel movements regular and is very effective in curing constipation. The pineapple juice works effectively in getting rid of motion sickness or nausea, morning sickness and vomiting sensation, relieve bronchitis, chest congestion and diphtheria. The high Vitamin C content in pineapple prevents gum disease and formation of plaque.

FOOD USES^[19]

The flesh of the fruit is eaten fresh, as salads, in deserts and cooked in cakes, pies, puddings, or garnish on ham or can be made into sauces. Pineapple is used in curries and various meat dishes by Malayans. Nowadays it is widely used in beverages.

PINEAPPLE WASTE^[20]

The by-products of the Pineapple consist basically of the residual pulp, peels, steam and leaves. There is massive waste generation, due to increasing production of the pineapple processed items, which is mainly due to the selection and elimination of the components that are unsuitable for human consumption. 55% of product waste is caused due to the rough handling of the fruits as well as exposure to adverse environmental condition during transport and storage. Now-a-days an eco-friendly utilization of pineapple by products is becoming more and more beneficial.

Chemical composition of pineapple waste								
Parameters	Ensiled	Fresh	Dry	Peel	Whole	Skin	Crown	Pulp
Moisture %	72.49	71.07	27.43	92.2	-	-	-	-
Total Solid %	27.51	29.03	72.57	7.8	-	-	-	-
Volatile solids %	87.12	96.12	95.9	89.4	-	-	-	-
pH	4	4.7	4.7	-	-	-	-	-
Ash %	12.88	3.88	4.1	10.7	0.7	0.6	0.4	0.2
as % dry basis								
Cellulose	9	11.2	12	19.8	19.4	14	29.6	14.3
Hemicellulose	4.7	7	6.5	11.7	22.4	20.2	23.2	22.1
Pectin	5.1	6.7	7.1	-	-	-	-	-
Ether soluble solids	4	6.1	6.7	-	-	-	-	-
Protein	0.91	3.13	3.3	-	4.4	4.1	4.2	4.6
Reducing sugar	5	25.8	27.8	-	6.5	-	-	-
Non-reducing sugar	1.7	5.7	4.9	-	5.2	-	-	-
Total sugar	-	-	-	-	11.7	-	-	-
Lignin	9	11.52	11	-	4.7	1.5	4.5	2.3

Uses of pineapple waste^[21,22,24]

a) Extraction of Bromelain: Bromelain is the most valuable component from the pineapple waste which is also the crude extract. Bromelain has significant anti-inflammatory effects, anti-thrombotic, fibrinolytic activities and is an anti-cancer agent. It is present in stem known as stem bromelain and also in fruit as well as small amount of it is also found in pineapple waste. Reverse micellar system is used to extract and purify bromelain from crude aqueous extract of pineapple waste which includes core, peel, crown and extended stem. Commercial crude bromelain is purified by successive use of ion-exchange chromatography, gel filtration, and ammonium sulfate fractionation from pineapple stem. Natural stability of the fruit bromelain is almost 80% when stored at -4° C for 180 days, without any addition of additives.

b) Production of Ethanol and Hydrogen by separate hydrolysis and fermentation (SHF): At a concentration of 20 g/L a pre-treated peel in 0.01M phosphate buffer with pH 6 is used as SHF medium. By the inoculation of pineapple peel the SHF experiment started with the addition of the enzyme solution (Cellulase, 100 FPU/mL) in 50 mL working volume for 0 to 96 hours for which a filter sterile hydrolysate is produced from pineapple peel under optimum condition and used as a fermentation medium with no nutrient supplementation. Then free and immobilised cell of *Saccharomyces cerevisiae* and *Enterobacter aerogenes* with a loading of 20% (w/v) under anaerobic condition is operated and temperature controlled at 30° C. For determining sugar concentration and production of the ethanol and hydrogen the samples are collected every 6 hours for 4 days i.e. 96 hours.

c) Antioxidant activity of pineapple peel wastes (PPW): The antioxidant which are present in PPW

are phenolic compounds, vitamin A and vitamin C, ferulic acid. V Saraswaty evaluated the antioxidant activity of PPW using various concentrations of ethanol. The highest antioxidant property was shown by the water extract with Inhibition Concentration IC₅₀ value of extracts from dried and fresh PPW as antioxidant activity were found in the range of 0.8±0.05 to 1.3±0.09 mg.mL⁻¹ and 0.25±0.01 to 0.59±0.01 mg.mL⁻¹.

TOXICITY^[24]

P. P. Joy has studied the toxicity of pineapple in which it is inedible and poisonous when unripe which irritates the throat and act as a drastic purgative. There is a formation of bezoars (fibre balls) due to the excessive consumption of pineapple cores in the digestive tract.

CONCLUSION AND FUTURE PERSPECTIVE

From the literature survey it has been noted that, the perennial herb *Ananas Comusus* has many surprising and wonderful benefits including its anti-microbial and anti-oxidant activities and thus can be used over synthetic ingredients. As reported, the major benefits of *Ananas Comusus* are majorly because of the presence of vitamin C and bromalein. Further it can also be noted that due to the presence of many other bio- active compounds it has a potential to be used in cosmetic products, so further studies on its formulation in cosmetic products and evaluation parameters can be done. Not only the fresh pineapple extracts but also its waste are highly rich in bromalein and vitamin C which is also beneficial to cosmetic industries and also the production of ethanol can be done from its waste. This ingredient has fascinating benefits as the fresh fruits well as its waste both can be used.

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