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Chemical content and bioactivities of *Artocarpus altilis*: A short review

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Abstract

Artocarpus altilis is a plant from Moraceae family, and it is known as Breadfruit. The multifarious importance of breadfruit includes food, medicine, clothing material, construction materials and animal feed. Extracts from different organs as roots and stem barks proved some antimicrobial effect against Gram-positive bacteria and have antitumor potential. The Phytochemical analysis of breadfruit revealed high content of amino acid, fatty acids, and carbohydrates. Bioactive compounds composition, antioxidant properties, protein and sugar content, lipids, were observed in the fruits.

Keywords: *Artocarpus altilis,* plants, chemical compounds, bioactivities.

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1. Introduction

Herbal ingredients are sometimes marketed for condition and ailments that were never considered in the traditional systems of medicines. Use of ephedra for weight loss or athletic performance enhancement is one of the examples. Most of the herbal/food products are sold and regulated as nutraceuticals, which does not require preapproval for these above criteria [1].

Most of the plants in the universe are known to possess therapeutic properties and have been used since ancient times to treat various human diseases effectively and efficiently. One such plant is *Artocarpus altilis* which belongs to the family, Moraceae. It is commonly referred to as breadfruit as it is similar to freshly baked bread. Breadfruit is a tropical fruit and the breadfruit tree produces fruits from March to June and from July to September [1].

Breadfruit is also known to be a traditional starch rich crop. The genus Artocarpus from Moraceae family comprises of approximately 50 species and is widely distributed in tropical and subtropical regions [2]. The generic name of the species comes from the Greek words 'artos' (bread) and 'karpos' (fruit) and the fruits eaten are commonly called breadfruit [3].

Basically Artocarpus species consists of phenolic compounds which include flavonoids, Jacalin, a lectin and stilbenoids. Artocarpus extracts and metabolites from leaves stem, fruit and bark contain numerous beneficial biologically active compounds and these compounds are used in the various biological activities including antibacterial, antitubercular, antiviral, antifungal, antiplatelet, antiarthritic, tyrosinase inhibitory and cytotoxicity [4].

The fruits are great source of carbohydrate and it has low fat. Since the fruit can be steamed, fried, baked, roasted and fried, they can be eaten at all stages of growth. This review provided information to future researchers on phytoconstituents and pharmaceutical importance of *A. altilis* in the field of medical science.

2. Chemical Compounds

A. altilis has various chemical constituents such as morin, dihydromorin, cynomacurin, artocarpin, isoartocarpin, cyloartocarpin, artocarpesin, oxydihydroartocarpesin, artocarpetin, norartocarpetin,

cycloartinone, β-sitosterol, ursolicacid, betullic acid acetate and artocarpanone. It has been reported that the heart wood contains cellulose 59.0 %, glucosides 38.0%, moisture 6.7%, lipids 0.7% and albumin 1.7%. The plant also has some essential Amino acids like Arginine, Cystine, Histidine, Leucine, Lysine, Metheonine, Theonine, Tryptophan and free sugersucrose), fatty acids, and ellagic acid [5].

Bark has betullic acid and two new flavone pigments, cycloheterophyllin. Triterpenic compounds like cycloartenyl acetate, cycloartenone have also been reported. Heterophylol a phenolic compound was obtained from A.altilis. There is only 3.3% tannin in the bark. The leaves and stem show the presence of sapogenins, cycloartenone, cycloartenol, β-sitosterol and tannins, they show estrogenic activity. A root contains β-sitosterol, ursolic acid, Betulinic acid and cycloartenone. Arcommunol C, D and E, squalene, stigmasterol, phytol, ployprenol, dihydrochalcones, hydroxyartoflavone, artogomezianone, furanocyclocommurin, prenylated stilbenes [5].

3. Biological Activities

3.1 Antimicrobial potential

The methanolic leaf extracts at a high concentration and ethyl acetate and petroleum ether leaf extracts of *A. altilis* at low concentration were found very much effective against all the four types of microbes studied and showed highest antimicrobial activity. This result showing the bioefficacy of different leaf extracts of *Artocarpus altilis* against various human pathogens might be due to the presence of different phytoconstituents which was further evidenced through their individual action on the growth of these pathogens, especially the presence of tannins [6]. An effective defense mechanism against these human pathogens was developed by the action of these secondary metabolites through inhibiting their growth [6].

The methanolic leaf extracts of *Artocarpus altilis* has tannins have been found to form irreversible complexes with proline-rich proteins and these compounds are known to be biologically active resulting in the inhibition of the cell protein synthesis as a result of which microbial growth is inhibited [7].

Tannins also react with proteins and act as stable and potent antioxidants which fight against various toxins released from the microbes. The activity of proteolytic enzymes used by plant pathogens were highly inhibited by tannins. Many plants have non-toxic glycosides that can get hydrolyzed to release phenolics that are toxic to microbial pathogens.

3.2 Antitubercular and Antiplasmodial potentials

Dichloromethane extract from the root stems of *Artocarpus altilis* and prenylated flavones, which are cycloartocarpin, artocarpin, and chaplashin; and six compounds from the root barks, morusin, cudraflavone B, cycloartobiloxanthone, artonin E, cudraflavone C and artobiloxanthone. They performed antitubercular activity against *Mycobacterium tuberculosis* H37Ra using the micro plate Alamar blue assay (MABA) and the antimalarial activity against the parasite *Plasmodium falciparum* (K1, multidrug-resistant strain) using the microculture radioisotope technique. They concluded that these prenylated flavones exhibited antitubercular and antiplasmodial activities, while exhibiting moderate cytotoxic activity towards KB (human oral epidermoid carcinoma) and BC (human breast cancer) [8].

3.3 Antioxidant potential

Antioxidant activity of flavonoids isolated from heartwood and cortex of *Artocarpus altilis* including their inhibitory effects on mushroom tyrosinase and melanin biosynthesis in vitro was studied. They assessed the ability of the prenylated flavonoids including 10-oxoartogomezianone, 8-geranyl-3-(hydroxyprenyl)isoetin, hydroxyartoflavone A, isocycloartobiloxanthone, and furanocyclocommunin, together with 12 other known compounds to scavenge the DPPH, ABTS+ radical cation, and the superoxide anion (O_2), and their capabilities to inhibit tyrosinase and melanin production in order to identify the natural antioxidants and whitening agents. Their investigation resulted in compounds hydroxyartoflavone A, isocycloartobiloxanthone and artoflavone A having moderate DPPH-scavenging activity, whereas compound isocycloartobiloxanthone exhibits significant ABTS+-scavenging activity, and that norartocarpetin and artogomezianone exhibits moderate ABTS+-scavenging activity, with compounds 8-geranyl-3-(hydroxyprenyl)isoetin, norartocarpetin, and artocarpin displaying good superoxide anion-scavenging activity and so these flavonoids are suitable as antioxidants and/or skin-whitening agents. However, further investigations are required to determine their mechanisms of action [9].

3.4 Alpha Amylase and Alpha Glucosidase Inhibitor

The inhibitory activity of methanolic extracts of *Artocarpus altilis*, *Cinnamomum zeylanicum*, Piper betel and *Artocarpus heterophyllus* on *Wheat alpha* amylase and Baker's yeast alpha glucosidase at varying concentrations was studied. They concluded that the methanolic extracts of the all the plants efficiently inhibited alpha glucosidase enzyme in vitro. However, only *Artocarpus heterophyllus* can be useful in the management of postprandial hyperglycaemia [10].

3.5 Anthelmintic potential

The antiparasitic potential of the leaf of phenolics containing *Artocarpus altilis* (Parkinson) var. seminifera and var. non seminifera and *Terminalia cattapa* L., against

the gastro intestinal nematode (GIN) *Haemonchus contortus* was investigated. There in vitro assay results showed the A extract of *Terminalia cattapa* L. dead leaves exhibited egg hatching inhibition compared with the negative control while the A extract of *T. cattapa* L. dead leaf and the M extracts of *T. cattapa* L., *A. altilis* (Parkinson) var. seminifera and var. non seminifera dead leaf exhibited larval development inhibition compared with negative control [11].

3.6 Antiausteric potential

The methanolic leaves extract of the *Artocarpus altilis* has maximum preferential cytotoxicity against PANC-1 human pancreatic cancer cells under nutrient-deprived conditions at a concentration of 50µg/mL. They successfully isolated eight new geranylated dihydrochalcones named sakenins A-H together with four known compounds of the methanolic leaves extract of *A. altilis*. They have identified sakenins F and H as potent cytotoxic candidates [12].

3.7 Mosquito Deterrent

The chemicals in the dried male inflorescences of breadfruit which is responsible for mosquito, *Aedes aegypti* deterrence. They proved that the male breadfruit flowers and fatty acids has the ability as mosquito repellent via systematic bioassay-directed study of the hydrodistillate of *A. altilis* and all its fractions using adult *Aedes aegypti* females [13].

3.8 Antihypertensive effect

Breadfruit can be used as an antihypertensive by investigating the possible mechanisms of action of its aqueous extract and its effect on cytochromes P450 (CYP) enzyme activities. The aqueous leaf extract *A. altilis* was administrated intravenously via cannulated carotid artery of anaesthetized normotensive Sprague-Dawley rats. The rats are subjected to atropine, mepyramine, propranolol and N (G)-nitro-L-arginine methyl ester. Their result showed moderate inhibitions of cytochrome P450s (CYP3A4 and CYP2D6) enzyme activities and they concluded that the *A. altilis* produces negative chronotropic and hypotensive effects through α-adrenoceptor and Ca^{2+} channel antagonism [13].

3.9 Skin Lightening effect

The isolated inhibitory compounds from the extracts of *A. altilis* with methanol and subjected the active fractions obtained to chromatography method. They conducted the dendrite elongation study by using melanocyte cells, B16F10 [14].

4. Conclusion

This review proved different important aspects of *A. altilis* in context of pharmaceutical science it could be of potential value in commercializing the plant for its multifarious uses.

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