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Review Article

PHYTOCHEMICAL AND PHARMACOLOGICAL OVERVIEW OF ACEROLA CHERRY: A REVIEW

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ABSTRACT

This review paper is focused on phytochemical and pharmacological overview of Acerola cherry. It is native to tropical and subtropical America. It is a small cherry like fruit and is often referred to as the Barbados, the West Indian, or the Puerto Rican cherry. This review has been conducted to update the information that is available in different scientific literatures. It is observed that the fruits of Acerola cherry are the rich source of Vitamin C and also contains phytochemicals such as anthocyanidin, carotenoids and polyphenols. These components exhibit various pharmacological activities like Free radical scavenging activities and inhibitory effects on both alpha-glucosidase and advanced glycation end products (AGEs) production. It is used as an antioxidant, antimicrobial agent and antihyperglycaemic agent. The Present review article can act as database for the phytochemical and pharmacological activities for future prospect and research.

INTRODUCTION

Acerola cherry is the most common name of Spanish origin for *Malpighia emarginata* DC and *Malpighia glabra* L., which is native to tropical and subtropical America. It is a small cherry like fruit and is often referred to as the Barbados, the West Indian, or the Puerto Rican cherry. The habit of Acerola plant is borne on short stems on a shrub like tree which will grow to approximately 12 feet in height. The fruit of Acerola is fleshy varies in size, light reddish-yellow or deep red in colour having winged seed. The fruit is sweet to acid in taste (depending upon the genetic type), with no distinct or pronounced flavour. Some think the flavour of thoroughly ripe acerola and the fresh, raw juice made from it resembles that of tart strawberries [1-3].

Plant profile

Taxonomy of Acerola cheery [4,5]

Kingdom: plantae
Unranked: Angiosperms
Unranked: Eudicots
Unranked: Rosids
Order: Malpighiales
Family: Malpighiaceae
Genus: Malpighia
Species: *Malpighia emarginata, Malpighia glabra*

Description[6]

Acerola is an evergreen shrub or small tree with spreading branches on short trunk. It is usually 2-3m tall, but sometimes reaches up to 6 m in height.

Leaves

The leaves are simple ovate-lanceolate, 2-8 cm in length and 1-4cm in width, shortly petiolated. They are opposite, ovate to elliptic-lanceolate, and have entire or undulating margin with small hairs, which can irritate skin.

Flower

Flowers are bisexual and 1-2cm in diameter. They have five pale to deep pink or red fringed petals, 10

stamens and 6-10 glands on the calyx. The 3-5 flowers per inflorescence are sessile or short peduncled axillary cyme.

Fruit

Fruits are bright red drupes, 1-3 cm in diameter with pulpy mass. Drupes are in pairs or groups of three, and each contains three triangular seeds. The drupes are juicy and very high in vitamin c and other nutrients. They are usually sour or sweet in taste.

Distribution [7]

It is originally from Yucatan, and can be found in Mexico, Central America, South America and the southern region of Brazil. It is cultivated in the tropics and subtropics throughout the world including the Canary Islands, Ghana, Ethiopia, Madagascar, Zanzibar, Srilanka, Taiwan, India, java, Hawaii and Australia.

Chemical constituent

Polyphenol, anthocyanin, Vitamin C, and Vitamin B.

Uses

- As food supplement.
- Sources of iron, calcium and phosphorus.
- Source of Vitamin C and B.

Nutritional profile [8]

Table 1: Nutritional value per 100gm of raw acerola fruit (energy 32 kcal)

S.No	Nutrients	Wt. in gm/mg/µg
1.	carbohydrate	7.69gm
2.	Dietary fibre	1.1gm
3.	fat	0.3gm
4.	protein	0.4gm
5.	Vitamins • Vitamin A • Thiamine (B_1) • Riboflavin(B_2) • Niacin (B_3) • Pantothenic acid (B_5) • Vitamin B_6 • Folate B_9 • Vitamin C	 38 µg 0.02mg 0.06mg 0.4mg 0.309mg 0.009mg 14 µg 1677mg

Table 2: trace elements present in acerola fruits

s.no	trace elements	Wt. in mg
1.	calcium	12mg
2.	Iron	0.2mg
3.	Magnesium	18mg
4.	Manganese	0.6mg
5.	Phosphorus	11mg
6.	Potassium	146mg
7.	Sodium	7mg
8.	Zinc	0.1mg

Phytochemical profile

Five different polyphenolic compounds were identified in the samples by means of HPLC and diode-array detection: chlorogenic acid, (−)-epigallocatechin gallate, (−)-epicatechin, procyanidin B1 and rutin, being the two last predominant. By means of solid phase extraction (SPE) three soluble polyphenolic fractions (phenolic acids, anthocyanins and flavonoids) were separated from the different sample extracts [9].

Three novel norfriedelanes, A–C (1–3), were isolated from the branches and roots of Malpighia emarginata. Their structures and absolute configurations were determined by 1D and 2D NMR techniques and X-ray crystallographic analysis. Norfriedelin A possessing an α-oxo-β-lactone group and norfriedelin B possessing with a keto-lactone group respectively [10].

Carotenoid composition has been investigated in acerola fruits (Malpighia emarginata DC. syn. Malpighia glabra L.) and derived products. In the ripe fruit, four major carotenoids were identified (-carotene, -cryptoxanthin, lutein, and violaxanthin) together with other minor carotenoids (neoxanthin, antheraxanthin, neochrome, luteoxanthin, auroxanthin, -cryptoxanthin-5,6-epoxide, -cryptoxanthin-5,8-epoxide, cis--carotene, and cis-lutein)[11].

Two anthocyanins, cyanidin-3-alpha-O-rhamnoside (C3R) and pelargonidin-3-alpha-O-rhamnoside (P3R), and quercitrin (quercetin-3-alpha-O-rhamnoside), were isolated from acerola (Malpighia emarginata DC.) fruit [12].

Phytochemical study of the aerial parts of acerola (*M. emarginata*) has resulted in the isolation of three new degraded diterpenes **1**–**3**, which is characterised by tetranorditerpenes acerolanins A–C (1–3) with a rare 2*H*-benz[*e*]inden-2-one substructure were isolated. Their structures were determined on the basis of spectral studies and acerolanin C was confirmed by X-ray crystallographic analysis [13].

Pharmacological profile

Free radical and Antioxidant activity

Polyphenol isolated from acerola fruit is anthocyanins, cyanidin-3-alpha-O-rhamnoside (C3R) and pelargonidin-3-alpha-O-rhamnoside (P3R), and quercitrin (quercetin-3-alpha-O-rhamnoside), were evaluated for Free radical and Antioxidant activity based on the functional properties associated with diabetes mellitus or its complications, that is, on the radical scavenging activity and the inhibitory effect on both alpha-glucosidase and advanced glycation end product

(AGE) formation. C3R and quercitrin revealed strong radical scavenging activity [12].

The contribution of ascorbic acid and phenolic compounds in the total antioxidant capacity of the extracts were evaluated. The extracts showed high total phenolic values and possessed high antioxidant activity as expressed by 2,2′-diphenyl picrylhydrazyl (DPPH) and oxygen radical absorbance capacity assays (ORAC). The ascorbic acid content ranged from 405 to 1744 mg/100 g of fruit on a fresh weight basis. The antioxidant capacity of the phenolic fractions was in the following order: anthocyanins<phenolic acids< flavonoids. The phenolic fractions contributed 7.1–36.5% of the antioxidant activity expressed by ORAC, whereas the contribution of ascorbic accounted for 18–39% of the total activity[14].

Antioxidant activity (DPPH radical activity, reducing power, SOA activity, total phenolic content and total flavonoid content) were evaluated in Indian variety of acerola and its squash. The average scavenging DPPH radical activity, reducing power assay and super oxide anion radical activity of acerola fruit ranges from 89.12 ± 0.42% inhibition, 3.047±0.01 absorption, 71.110±1.68%, and acerola squash was reported relatively less antioxidant properties. Total phenolic and total flavonid content of fruit is high and reported 809.143±37.792 µg of PE (pyrocatechol equivalent) and 47.947±0.358 µg RE (Rutin equivalent) respectively[15].

Antihyperglycaemic or Antidiabetic effect

A crude acerola polyphenol fraction (C-AP) was prepared by subjecting an acerola extract to a C18 cartridge column, and eluting the adsorbed fraction with ethanol containing 10% of acetic acid. C-AP appeared in a previous study to have an inhibitory effect on alpha-glucosidase and particularly on maltase activities. To elucidate the antihyper glycemic effect of C-AP further, we examined the regulation by C-AP of glucose uptake in Caco-2 cell; this resulted in the inhibition of glucose uptake. We next conducted single administration tests of glucose and maltose to ICR mice to investigate whether C-AP really controlled the intestinal glucose absorption in an animal body. The results showed that C-AP significantly suppressed the plasma glucose level after administering both glucose and maltose, suggesting that C-AP had a preventive effect on hyperglycemia in the postprandial state. The mechanism for this effect is considered to have been both suppression of the intestinal glucose transport and the inhibition of alpha-glucosidase. Despite such a preventive effect, the therapeutic effect of C-AP on hyperglycemia appeared to be low from the experiment with KKAy mice[16].

Cytotoxicity Activity

The cytotoxicity of compounds **1**–**3** was tested against human breast cancer (MCF-7), hepato-cellular carcinoma (SMMC-7721), myeloid leukemia (HL-60), lung cancer (A-549) and colon cancer (SW480) cell lines using an MTS (3-(4,5-dimethylthiazol-2-yl)-5-(3-carboxymethoxyphenyl) -2-(4-sulfophenyl)-2*H*-tetrazolium inner salt) assay, with cisplatin (Sigma-Aldrich, St. Louis, MO, USA) as the positive control. All the cell lines were obtained from Shanghai cell bank in China and were cultured in RPMI-1640 or DMEM medium (Hyclone, Logan, UT, USA), supplemented with 10% fetal bovine serum (Hyclone, Logan, UT, USA) at 37 °C in a humidified atmosphere containing 5% CO2. The viability of cells was determined by performing colorimetric measurements of soluble formazan formed through the reduction of MTS in living cells. In brief, 100 µL medium containing 5,000 cells were plated in each wells in 96 well plates and allowed to adhere for 24 h before drug treatment, while suspension cells were seeded just before drug addition at a concentration of 1 × 105 cells/mL. Cells were exposed to the test compound dissolved in dimethyl sulfoxide (DMSO) at different concentrations in triplicates at 37 °C for 48 h. At the end of the incubation, the medium were replaced with MTS medium (317 µg/mL), and then the incubation was continued for 4 h at 37 °C. The optical densities of the cell lysates were measured at 490 nm using a micro plate reader (Bio-Rad Laboratories, Hercules, CA, USA). The cell viability was calculated by the following formula: cell viability (%) = (OD sample/OD control) × 100%.[13]

Toxicity studies

preliminary toxicological and safety evaluations of crude APs (C-AP), which were obtained by eluting an XAD7HP column-adsorbed fraction of APs with 70% ethanol containing malic acid. The total polyphenol content of C-AP was 57.7% with the main polyphenols being proanthocyanidin and cyanidin-3-alpha-O-rhamnoside. For toxicological evaluations, C-AP was administered orally to rats at doses of 2000 mg/kg body weight (acute) or 100, 300, and 1000 mg/kg body weight/d for 28 (subacute) and 90 (subchronic) d. In the acute oral toxicological test, no deaths or abnormalities at necropsy on day 14 were observed, confirming that the minimum fatal dose of C-AP is greater than 2000 mg/kg body weight. In both sub acute and sub chronic toxicological tests, no death was recorded and the body weights and food intakes of the rats

did not differ significantly from the control groups. Besides, there were no abnormal clinical signs related to administration of C-AP in any of the experimental animals. [17]

Antimicrobial activity

Some Selected extracts from the flavonoids fraction showed some activity against *Staphylococcus aureus* [14].

Future prospect

Acerola cherry chemically contains polyphenol and vitamins, having great antioxidant and free radical scavenging property so it may be used as cardioprotective, renoprotective, hepatoprotective and anticancer agent for future.

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