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MINI REVIEW

Anti-acne activity of *Garcinia mangostana* L.: A review

Panupon Khumsupan and Wandee Gritsanapan✉

Abstract

***Garcinia mangostana* L. or mangosteen of the Clusiaceae has traditionally been employed as medicinal drugs for decades. A plethora of compounds are responsible for a wide range of medicinal properties and biological activities. The ethanol extract of the mangosteen rind has been found to be anti-inflammatory, antioxidant and anti-acne-causing bacteria. Many research studies have confirmed its potency, with the ethanol extract of the rind being able to inhibit pro-inflammatory cytokines (TNF-α) at relatively low concentration. DPPH assay also revealed its potent radical scavenging activity. The compound responsible for the antibacterial activity, α-mangostin, was especially potent and one of the compounds responsible for the anti-bacterial activity.**

Keywords: *Garcinia mangostana*; mangosteen; acne.

Introduction

Garcinia mangostana L., colloquially known as mangosteen, is one of the most economical tropical fruits among the Southeast Asian countries (Somsri & Manassakorn, 2006). Famously known for its sweet taste and uniquely pleasant aroma, it had been given a title "The queen of fruits." In addition to being popularly consumed, it also contains invariably nutritious compounds that are beneficial for the body. Many parts of the plant have long been utilized ethnologically as medicinal herb. For instance, dried powder fruit hull has been used as a wound-healing agent, to treat skin infection, suppuration and chronic ulcer (Saralamp, Chuakul, Temsiririkkul, & Clayton, 1996). Leaves and bark are strongly anti-inflammatory and the ointment derived from them can be used to treat eczema, hyperkeratosis and psoriasis. The root decoction is administered to treat menstrual disorder (Farnworth & Bunyapraphatsara, 1992). The tea made from fruits is used as tonic for fatigue and low energy state, to aid digestive system and to treat parasitic skin infection (Obolskiy, Pischel, Siriwatanametanon, & Heinrich, 2009). Botanically, mangosteen is a small to medium height evergreen tree, 6-25 m, sap yellow with a straight trunk, symmetrically branched to form a conical crown. All parts of the plant contain yellow latex (Somsri & Manassakorn, 2006).

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AUTHORS' AFFILIATION
Department of Pharmacognosy, Faculty of Pharmacy, Mahidol University, Bangkok 10400, Thailand

CORRESPONDENCE
✉ Dr. W. Gritsanapan Tel. +66 2 6448677-89 ext 1500, 5530 Fax +66 2 6448701 E-mail : wandee.gri@mahidol.ac.th; wandeegrit@yahoo.co.th

Compounds in *G. mangostana*

Technological advances in chromatography and structural elucidation have given tremendous insight to active constituents responsible for myriad of the aforementioned medicinal properties. Much of the focus has been given to the rind since it is consumption byproduct and could be readily utilized. More than sixty xanthones have been elucidated in addition to tannins, flavonoids, and phenolic compounds, which are responsible for mangosteen's anti-inflammatory and antioxidant activities. Some of the compounds found especially in the rind, for example, the major compound, α-mangostin, have also been labeled to be anti-bacterial against acne-causing bacteria (Jung, Su, Keller, Mehta, & Kinghorn, 2006; Peres, Nagem, & de Oliveira, 2000; Vieira & Kijjoa, 2005).

Biological activities

The area of study of exploiting mangosteen rind to treat acne is relatively new and a lot of studies have yet to be conducted to find out which individual compound contributes to the anti-acne activity. However, the major compound α-mangostin has been ascertained to be

formidably active against acne-causing bacterial, *Propinobacterium acnes* and *Staphelococcus epidermidis* (Chomnawang, Surassmo, Nukoolkarn, & Gritsanapan, 2005). Altogether, the anti-inflammatory (Chomnawang, Surassmo, Nukoolkarn, & Gritsanapan, 2007), antioxidant and antibacterial properties (Pothitirat, Chomnawang, Supabphol, & Gritsanapan, 2010) directly target acne's pathogeneses. When used in conjunction with an agent that promotes epidermal desquamation, α-mangostin could boast a potentially potent or even commercially beneficial active medicinal compound.

Table 1: Systematic classification (taxonomy) of *G. mangostana* (USDA, 2014)

Taxon	
Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Dilleniidae
Order	Theales
Family	Clusiaceae (Guttiferae)
Genus	*Garcinia*
Species	*Garcinia mangostana* Linn.

Chomnawang, *et al*. investigated the effectiveness of *G. mangostana* in comparison with six other medicinal plants and found that *G. mangostana* was the leading candidate against acne. At the concentration of 50 µg/ml of crude ethanol extract, it was able to inhibit 99.59 % of pro-inflammatory cytokines (TNF-α) produced by human peripheral blood mononuclear cells. DPPH scavenging assay also revealed its potent antioxidant activity, with the half-maximal inhibitor concentration (IC_{50}) of 6.13 µg/ml and 77.80 ± 1.28 % superoxide radical inhibition ratio, the lowest among medicinal herbs tested (Chomnawang *et al*., 2005).

The antibacterial activity of *G. mangostana* has also been investigated by Pothitirat *et al.* Fruit rinds from thirteen different locations in Thailand were extracted with ethanol and tested against *P. acnes* and *S. epidermidis*. The average minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) against *P. acnes* were 13.22 µg/ml and 18.82 µg/ml, respectively, while those against *S. epidermidis* were 24.04 µg/ml and 86.54 µg/ml, respectively. However, pure α-magostin displayed a highly potent activity, having the MIC and MBC of 1.95 µg/ml against *P. acnes* and 3.91 µg/ml against *S. epidermidis*. From this, it could be inferred that α-magostin is one of the contributing compounds responsible for the anti-acne activity in mangosteen extract (Pothitirat, Chomnawang, & Gritsanapan, 2008).

Extraction method and solvent used give rise to differences in terms of α-mangostin content and hence, biological activity. It would seem like α-mangostin, phenolics and tannins in the rind are relatively tolerable to heat since Soxhlet extraction method did not hinder the extraction of these compounds compared to other methods where heat was not applied. The extract from Soxhlet extraction using 50% ethanol also promoted the lowest effective concentration that gives half-maximal response (EC_{50}) 12.84 ± 0.08 µg/ml tested by DPPH-scavenging assay. The extract of 95% ethanol from Soxhlet extraction also promoted the lowest MIC against *P. acnes*, 7.81 µg/ml (Pothitirat *et al*., 2010).

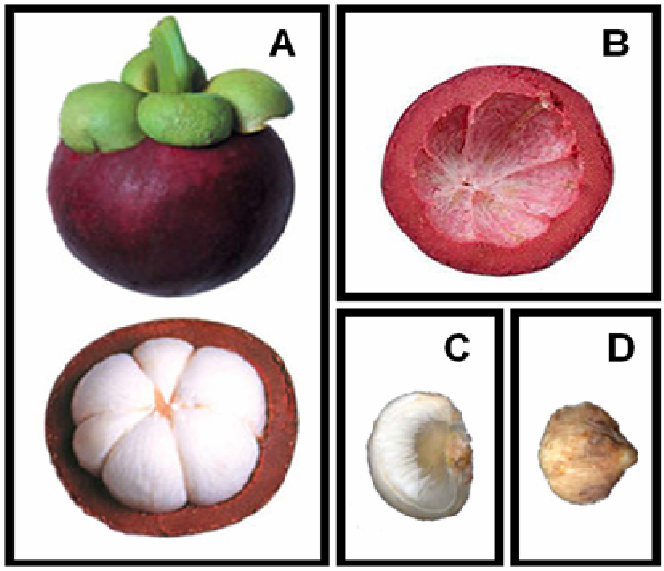
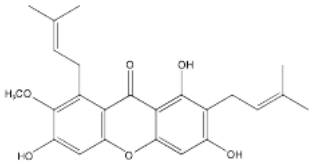
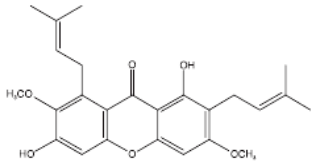
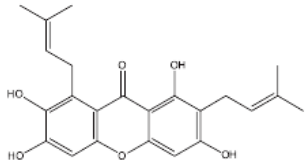


Fig 1. Mangosteen fruit (A), rind (B), pulp (C), and seed (D)

The investigation on the solvent that would yield the highest amount of α-mangostin was also performed and it was found that dichloromethane was the solvent that yielded 46.21 ± 2.46 % of α-mangostin w/w of extract. This number is much higher than other solvents, hexane and ethanol, and very likely was the reason for dichloromethane extract's lower MIC and MBC against both *P. acnes* (3.91 µg/ml) and *S. epidermidis* (3.91 and 15.63 µg/ml, respectively) (Pothitirat *et al*., 2008).

Apparently, different maturity stages also affected the amount of active constituents in the rind. Young mangosteen rind contained less α-mangostin (8.07 ± 0.11 vs 13.63 ± 0.06 % w/w of extract) and flavonoids (2.91 ± 0.09 vs 4.08 ± 0.07 g QE/100 g extract) but more phenolics (42.57 ± 0.11 vs 28.88 ± 0.73 g GAE/100 g extract) and tannins (51.25 ± 0.20 vs 36.66 ± 0.43 g TAE/100g extract), causing it to be more anti-oxidative than the mature rind with the EC_{50} of 5.56 ± 0.12 µg/ml compared to 10.94 ± 0.06 µg/ml of the mature rind. The mature rind, containing more α-mangostin, possessed relatively better antibacterial activity, with the MIC and MBC against *P.*

Table 2: Some of the xanthones present in *G. mangostana* (Khumsupan & Gritsanapan, 2013)

Name	Structure	Plant parts	Biological activities
Alpha-mangostin		Pericarp, Whole fruit, Stem, Arils, Seed	- Antioxidant - Antimicrobial (*M. tuberculosis, S. aureus, P. acnes*) - Anti-inflammatory
Beta-mangostin		Pericarp, Whole fruit, Stem	- Antibacterial (*S. aureus*) - Cytotoxicity (Human leukemia H60 cell)
Gamma-mangostin		Pericarp, Whole fruit	- Antioxidant - Antimicrobial (*M. tuberculosis, S. aureus, P. acnes*) - HIV I protease inhibiting activity

acnes being 15.63 µg/ml, compared to 15.63 µg/ml (MIC) and 31.25 µg/ml (MBC) of the young rind (Pothitirat, Chomnawang, Supabphol, & Gritsanapan, 2009).

Chemical and biological stability

Stability is one of the most important aspects that should be taken into consideration when choosing a compound for formulation. *G. mangostana* extract has proven to be quite stable, with the active constituent remaining more than 90% after the accelerated stability study. A study was conducted where the ethanol extract was kept in amber glass vials and aluminum foil bag at three different temperatures, 4-8°C, 25-28°C and 45°C. After 120 days, there were no significant changes to the α-mangostin content, antioxidant activity and antibacterial activity in all samples (Pothitirat, Pithayanukul, Chomnawang, Supabphol, & Gritsanapan, 2009).

Conclusion

Aside from being tasty and nutritious, mangosteen also possesses many biological properties that could be useful in the field of medicine. Although many medicinal aspects of mangosteen have been investigated, the research on the anti-acne activity is still much limited. Like most medicinal herbs, a lot of research has to still be done to fully grasp its complexity. Certainly, mangosteen harbors practical potential, as evident in ethnopharmacology and supported studies, to be developed into many products. Plausibly, the ethanol extract of the rind, which possesses relatively strong anti-acne activity, could be formulated and commercialized to alleviate the bacterial-resistant epidemic.

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