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Antioxidant Potential of *Garcinia cowa* Roxb. : A Review

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Abstract:

Oxidative stress and inflammation are two common risk factors in the pathogenesis of various life-threatening diseases. In recent years, antioxidant-rich medicinal plants have been extensively researched for their potential role in disease treatment and prevention. *Garcinia cowa* (Family Guttiferae) has been used as traditional medicine in many countries around the world. It contains numerous chemicals with various bioactivities, including anticancer, antidiabetic, and antihyperlipidemic. These effects are thought to be related to the radical scavenging effect, due to their antioxidant activities, along with other possible mechanisms such as anti-inflammatory properties. Therefore, the present review provides in-depth knowledge about the antioxidant potential of *Garcinia cowa*. This review provides evidence in the literature for the *Garcinia cowa*, from 2000 to 2022. Three bibliographic databases were used as primary sources of information (PubMed, ScienceDirect, and Google Scholar). The keywords in this research were "Antioxidant", “Asam Kandis”, and " *Garcinia cowa*". A total of 10 studies were included in this review according to the required criteria. *Garcinia cowa* has powerful antioxidant characteristics, to remove free radicals. It is clear that Garcinia cowa, with different plant parts and diverse concentrations, can have varied antioxidant capacities.

***Keywords**:* Antioxidant, *Garcinia cowa*, Asam Kandis

1. Introduction

Antioxidant activity refers to a bioactive compound's ability to maintain cell structure and function by effectively removing free radicals, inhibiting lipid peroxidation reactions, and preventing other forms of oxidative damage [1]. It is also the basis for many other biological functions, such as anti-cancer, anti-inflammation, antidiabetic and anti-aging [2]–[4]. More importantly, the prevention of many chronic diseases, such as cancer, diabetes, and cardiovascular disease, has been suggested to be associated with antioxidant activity [5]. Therefore, a deep study of natural antioxidants, such as those from fruits and vegetables, is of great importance to human health [6]. *Garcinia cowa* (Family *Guttiferae*) is a tree with edible fruits and leaves distributed in tropical Asia, Africa, and Polynesia and found in Indonesia [7]. Plants of the genus *Garcinia* have been used as traditional medicines in many countries around the world [8]. Traditionally, *Garcinia cowa* or Asam Kandis has been used by Minang tribes for many purposes. Phytochemical investigations of Asam Kandis resulted in the isolation of xanthones, benzophenones, dyhydrobenzopyran, acylphloroglucinol, depsidone, and tetraprenyltoluquinone [9]. The search for natural antioxidants with the virtue of being nontoxic has given rise to a large number of studies on the antioxidant potential of *Garcinia cowa*. This is particularly relevant because most common synthetic antioxidants (such as butylated hydroxyanisole (BHA) or butylhydroxytoluene (BHT)) are suspected to be potentially harmful to human health [10]. On the other hand, reports on *Garcinia cowa*

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antioxidant properties from different scientific fields or from different laboratories are sometimes contradictory, often because of diverse experimental settings, which make it difficult any comparison the results. Some of the methods used to assess *Garcinia cowa* antioxidant performance suffer from limitations that, if not adequately addressed, may compromise the significance of results. The aim of this review is not to offer a comprehensive survey of the literature but to highlight their antioxidant potential. Methods used to assess their antioxidant performance will be critically reviewed. Most importantly, the antioxidant properties of *Garcinia cowa* were summarized for the first time.

2. Data Collection

The present review was performed using databases, including Google Scholar, ScienceDirect, and PubMed. In this update, the search terms "Antioxidant", "Asam Kandis", and "G*arcinia cowa* Roxb." Were collected from 2000-2022 as the main source of information. We restricted the literature search to English and Indonesian language reports.

The search strategy as described above was done by two authors. The search was done using the combinations of keywords mentioned above. Titles and abstracts were screened, and the full text was assessed where necessary. Studies reported in a language other than English and Bahasa were excluded. Studies with unclear presentation or incomplete data were also not included in this review. The plant taxonomy has been verified from the "Plant List" database (www.theplantlist.org).

3. Result and Discussion

Garcinia cowa Roxb has antioxidant properties, according to in vitro studies. Based on our eligibility requirements, A total of 10 studies were included in this review according to the required criteria. The anti-antioxidant properties of G*arcinia cowa* are summarized in Table I.

Table. 1 Antioxidant properties of the *Garcinia cowa*

References	Assay/Methods	Plant part/Source	Sample	Dose/ Concentration	Antioxidant activity
[11]	DPPH method	Leaves	a. Ethanol extract b. n-hexane fraction c. Ethyl acetate fraction	100, 50, 25, 12.5, and 6.25 µg/ml	a. 41.36 µg/ml (IC_{50}) b. 71.84 µg/ml (IC_{50}) c. 29.36 µg/ml (IC_{50})
[12]	Ferric Reducing Antioxidant Power (FRAP) assay	Leaves, rind, and stem bark	Ethanol extract	0.1 mL	25.968, 25.137 and 26.837 mmol Fe(II)/100 gram
[13]	DPPH method	Fruit rinds	Peel off masks of the Ethanolic extract	10 mg/ml	82,64%
[14]	DPPH method	Dried fruit	Methanol extract	50 µl – 700 µl	10,34µg/ml (IC_{50}) 5,54% (TAA)
[15]	DPPH method	Leaves	n-hexane fraction	500; 250; 125; 62,5; dan 31,25 µg/ml	308,96 µg/ml (IC_{50})

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[16]	β-carotene Linoleic acid model system	Bark	a. Hexane extract, b. Acetone extract c. Methanol extract d. Ethyl acetate extracts	50 µg/mL	a. 82,60 % b. 76,57% c. 83,74% d. 68,54%
[16]	Superoxide radical scavenging method	Bark	a. Hexane extract b. Acetone extract c. Methanol extract d. Ethyl acetate extracts	50 µg/mL	a. 32.32 % b. 29.90 % c. 15.68 % d. 10.29 %
[17]	β-carotene-linoleate-model system	Dried fruit rinds	a. Hexane extract b. Chloroform extract	200 µg/ml	a. 91,7% b. 93,7%
[17]	DPPH method	Dried fruit rinds	a. Hexane extract b. Chloroform extract	50 µg/ml	a. 83,3% b. 86,3%
[18]	DPPH method	Leaves	Methanol extract	1,000, 500, 100, 50, 10 and 1 µg/ml	1597.5 ± 99.3 µg/mg (EC_{50})
[19]	Phosphomolybdenum method	Dried rinds	a. Hexane extracts b. Chloroform extracts	100 µg/ml	2681 and 2634 (as equivalent to Amoles of ascorbic acid/g of extract)
[19]	Potassium ferricyanide reduction method	Dried rinds	a. Hexane extracts b. Chloroform extracts	400 µg/ml	1.858 and 2.229 (abs)
[20]	DPPH method	The crude latex	a. Ethanol extract Isolated b. Compound (xanthones)	2.5, 1.25, 0.75, 0.5, 0.25, 0.125, 0.06 and 0.03 mg/mL	a. 13.20 µg/mL (IC_{50}) b. over 200 lM

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3. 1. Antioxidant properties

Free radicals are produced under certain environmental conditions and during normal cellular function in the body; these molecules miss an electron, giving them an electric charge. To neutralize this, charge, free radicals try to withdraw an electron from, or donate an electron to a neighboring molecule. The newly created free radical, in turn, looks out for other molecules and withdraws or donates an electron, setting off a chain reaction that can damage hundred of molecules[21]. *Garcinia cowa* has the potential to overcome the problems caused by free radicals as described by the following studies :

Jhofi *et al*, evaluated the antioxidant activity of the *Garcinia cowa* leaf ethanol extract, n-hexane, and ethyl acetate fraction. Antioxidant activity was carried out using the DPPH (2-2-diphenyl-1-picrylhydrazyl) assay. This study showed the ethanol extract had a very strong antioxidant of IC50 41.36 ± 1.25 µg/ml. The n-hexane fraction had strong antioxidants of IC50 71.84 ± 1.88 µg/ml. The ethyl acetate fraction had a very strong antioxidant of IC50 29.36 ± 1.25 µg/ml. The results of the percentage inhibition of the extract and the fraction at the same concentration showed that the ethyl acetate fraction had a higher percentage of inhibition than the ethanol extract and the n-hexane fraction, indicating that the ethyl acetate fraction had better free radical inhibitory activity than the ethanol extract and n-hexane fraction. The ethanol extract, n-hexane fraction, and ethyl acetate fraction of *Garcinia cowa* leaf had potential as a source of herbal medicine for antioxidants[11].

Rasyid *et al*. reported that antioxidant activities of ethanol extract of the leaves, rinds, and stem bark of *G. cowa* Roxb. were 25.968, 25.137 and 26.837 mmol Fe(II)/100 gram, respectively, and antioxidant activities of Gallic acid which was used as a reference standard was 9.338 mmol Fe(II)/100 gram.

In another investigation, Lucida *et al* found the *Garcinia cowa* rinds ethanol extract's inhibitory ability against DPPH radical oxidation increased with concentration, with the highest% inhibition being 82.64% at the highest concentration of extract (10 mg/ml), which was still lower than the value of % inhibition of vitamin C when tested under the same conditions, namely 98, 62% at a concentration of 3 mg/ml [13].

A study conducted by Gogoi *et al* reported that methanol extract of *Garcinia cowa* showed antioxidant activity with an IC_{50} value of 10.34µg/ml with a total antioxidant activity of 5.45%. From this study, it was observed that ascorbic acid was found in *Garcinia cowa* (63.86mg/100 g) and that of *Garcinia cowa* carotenoid content (8.85 g/g) [14].

A study was conducted by Fakhrur, 2016 on antioxidant activity using the DPPH free radical scavenging method with a test sample concentration of 500; 250; 125; 62.5; and 31.25 ppm. Gallic acid was used as a comparison with concentrations of 5, 10, 20, and 40 ppm. The results of the antioxidant activity test by the hexane fraction of kandis acid leaves showed the IC_{50} value at a concentration of 308.96 ppm. The results of this study concluded that the hexane fraction of kandis acid leaves had low antioxidant activity [15]

In addition, a study conducted by Sharma *et al*, reported the antioxidant activity of *Garcinia cowa* extract using the β-carotene Linoleic acid model system method, the results of this study showed that *Garcinia cowa* hexane and methanol extracts had higher activity than other extracts. At a concentration of 50 ppm, hexane extract showed 82.60% activity, while methanol extract showed 83.74% activity. Meanwhile, research using the superoxide radical method scavenging method showed that the hexane and acetone extract exhibited higher activity compared to other extracts. At 50 ppm concentration, hexane extract showed 32.32% activity and acetone extract showed 29.90% activity, while methanol and ethyl acetate extracts showed only 15.68% and 10.29% activity respectively [16].

A study conducted by Negi *et al*, reported the chloroform extract *Garcinia cowa* exhibited higher antioxidant ctivities than the of hexane extract. This study showed that both the extracts from the fruit rinds of *G. cowa* possess antioxidant properties [17].

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Furthermore, Nanasombat & Teckcuen reported that the methanol extract of *Garcinia cowa* had the antioxidant activity with EC50 value of 1597.5 µg extract/mg DPPH (AE = 62.7 × 10-5) [18].

A study conducted by Joseph *et al*, reported that the antioxidant capacity of both the hexane and chloroform extracts from the rinds of *G. cowa* was found to be 2681±7.65 and 2634±12.0 (as equivalent to mikromoles of ascorbic acid/g of extract) respectively, at 100 ppm concentration. The reducing powers of Garcinia extracts were also evaluated by reduction of ferricyanide method at 400 ppm concentration, the hexane and chloroform extracts from *G. cowa* showed the absorbance of 1.858 and 2.229, respectively. In the present study, the hexane and chloroform extracts from G. cowa were found to have significant antioxidant activity assayed phosphomolybdenum and reduction of ferricyanide methods. It appears that the antioxidant principles present in the *Garcinia cowa* extracts reduce oxidative stress [19].

A study conducted by Mahabusarakam *et al.* reported that the crude latex and pure compounds were examined for the radical scavenging activity by the DPPH assay. The crude latex was found to be able to scavenge the DPPH radical with a significant result, IC_{50} 13.20 µg/mL, whereas butylated hydroxytoluene (BHT), the standard antioxidant, exhibited activity with an IC_{50} 5.10 lg/mL. However, compounds (Xanthons named cowagarcinone A–E) showed poor radical scavenging activity, the IC_{50} values being over 200 µM. [20].

3.2. Methods for the antioxidant activity evaluation of *Garcinia cowa*

Nowadays, the antioxidant capacity of plants has been taken as an indicator of their beneficial effects on human health [1]. Therefore, a good method for the antioxidant activity evaluation of *Garcinia cowa* is of great importance. There are a wide variety of antioxidant activity evaluation methods for plant samples that have been reported in the existing literature [22]. To present a general view of the potential methods that can be used for the antioxidant activity evaluation of *Garcinia cowa*, we introduce the in vitro assays.

In vitro assays, also called chemical methods, are mainly concerned with the free radical or oxide scavenging capacity of the antioxidants. In the current literature, the major in vitro methods used for plant samples are 1,1-diphenyl-2- pierylhydrazy (DPPH), 2,2'-azino-bis(3-ethylbenzthiazoline-6-sulfpnic acid) (ABTS), oxygen radical absorbance capacity (ORAC), total radical-trapping antioxidant parameter (TRAP) , trolox equivalent antioxidant capacity (TEAC), ferric reducing-antioxidant power (FRAP), cupric ion-reducing antioxidant capacity (CUPRAC), and photochemiluminescence (PCL) [23], [24].

The principal advantage of these methods is speed and simplicity, but the disadvantage is that their results are influenced by many factors, such as antioxidants and interactions, interference materials, pH, action time, a producing system for free radicals, and so on [25]. With respect to *Garcinia cowa*, DPPH, FRAP, β-carotene Linoleic acid model system, Superoxide radical scavenging method, Phosphomolybdenum method, and Potassium ferricyanide reduction methods are often used to evaluate antioxidant activity.

4. Conclusion and Future Prospects

This review described the importance of *Garcinia cowa* as a potent natural antioxidant. *Garcinia cowa* has powerful antioxidant characteristics, to remove free radicals. It is clear that *Garcinia cowa*, with different plant parts and diverse concentrations, can have varied antioxidant activities. At present, it can be concluded that the ethanolic extract of *Garcinia cowa* from various parts of the plant still shows better antioxidant activity compared to others. However, further research needs to be done to understand the role of metabolites as antioxidants in the body as a start for the development of new antioxidant drugs in the future.

5. Acknowledgements

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6. Conflict of Interest

The authors declare that they have no conflicts of interest.

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