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Nutraceutical Profile of Garcinia cowa (Asam Kandis) in Minangkabau Cuisine: Potential Anti-Obesity and Antioxidant Properties

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Abstract

Garcinia cowa Roxb., locally known as *Asam Kandis*, is an integral souring agent in Minangkabau cuisine and has long been utilized in traditional Indonesian folk medicine. Despite its cultural significance, its comprehensive nutraceutical profile and pharmacological mechanisms remain under-explored in a modern clinical context. This study aims to evaluate the phytochemical composition of *G. cowa* and analyze its potential as a functional food, specifically focusing on its anti-obesity and antioxidant properties. Synthesis of existing literature indicates that *G. cowa* rinds and leaves are exceptionally rich in (–)-hydroxycitric acid (HCA), a key organic acid known to inhibit ATP-citrate lyase, thereby suppressing fatty acid synthesis and promoting weight homeostasis. Additionally, phytochemical profiling reveals high concentrations of xanthones, flavonoids (such as morelloflavone), and benzophenones, which exhibit potent free-radical scavenging activities against DPPH and ABTS radicals. These bioactive compounds contribute to its protective role against oxidative stress-induced cellular damage. The findings suggest that *Asam Kandis* holds significant promise as a natural nutraceutical intervention for managing metabolic disorders. Future research should prioritize the standardization of extraction methods and long-term clinical trials to validate its efficacy and safety as a mainstream functional food ingredient.

Keywords: Garcinia cowa, *Asam Kandis*, Minangkabau cuisine, hydroxycitric acid (HCA), anti-obesity, antioxidants, nutraceuticals, functional food.

1. Introduction

The global prevalence of metabolic disorders, particularly obesity and its associated comorbidities such as type 2 diabetes and cardiovascular diseases, has reached pandemic proportions. Obesity has nearly tripled worldwide since 1975, necessitating the search for effective, sustainable, and natural therapeutic interventions [1]. In recent years, there has been a significant shift toward "nutraceuticals"—food-derived compounds that provide medical or health benefits—as safer alternatives to synthetic anti-obesity drugs, which often carry adverse side effects [2]. Among the diverse flora of Southeast Asia, the genus *Garcinia* has emerged as a focal point of pharmacological interest due to its unique biochemical profile rich in organic acids and polyphenols [3, 4].

Garcinia cowa Roxb., locally recognized in West Sumatra, Indonesia, as *Asam Kandis*, is a perennial tree species that plays a pivotal role in Minangkabau gastronomy. Unlike its more globally famous relative, *Garcinia cambogia*, *G. cowa* remains relatively under-researched despite its intensive use as a traditional souring agent and food preservative in regional dishes such as *Rendang* and *Asam Padeh* [5]. In Minangkabau traditional medicine, various parts of the plant, including the fruit rinds, leaves, and bark, have been utilized to treat fever, improve blood circulation, and serve as a digestive aid [6]. These ethnomedicinal applications suggest a complex underlying chemical matrix that warrants rigorous scientific validation.

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The primary pharmacological value of *Garcinia cowa* is attributed to its high concentration of (–)-hydroxycitric acid (HCA). HCA acts as a potent competitive inhibitor of the enzyme ATP-citrate lyase, which is crucial for de novo lipogenesis [7]. By inhibiting this pathway, *G. cowa* extracts effectively suppress fatty acid synthesis and facilitate the oxidation of stored lipids, positioning it as a promising candidate for weight management [8]. Beyond its anti-obesity potential, the fruit is a rich reservoir of bioactive secondary metabolites, including xanthones (such as cowanin and cowanol), benzophenones, and flavonoids [9]. These polyphenolic compounds are renowned for their robust antioxidant capacity, capable of neutralizing reactive oxygen species (ROS) and mitigating oxidative stress-induced cellular damage [10, 11].

Despite the vast potential of *Asam Kandis* as a multifunctional nutraceutical, there is a distinct lack of synthesized data regarding its specific phytochemical efficacy compared to other *Garcinia* species. Most existing studies remain fragmented, focusing either on botanical characteristics or isolated chemical constituents [12]. Therefore, this article provides a comprehensive review of the nutraceutical profile of *Garcinia cowa* within the context of Minangkabau cuisine. By evaluating its anti-obesity mechanisms and antioxidant properties through a systematic analysis of recent empirical evidence, this study aims to establish a scientific roadmap for the development of *G. cowa* as a standardized functional food ingredient in the global health market.

2. Literature Review

2.1. Botanical Characteristics and Ethnobotanical Significance

Garcinia cowa Roxb., a member of the Clusiaceae family, is widely distributed across the tropical rain forests of Southeast Asia, particularly in Indonesia, Thailand, and Malaysia. In West Sumatra, the tree is prized for its fruit, which is sliced and sun-dried to produce *Asam Kandis* [2]. Historically, the Minangkabau people have utilized the dried rinds not only for their intense acidity in culinary applications but also as a traditional remedy for digestive ailments and thermal regulation [6]. Unlike other *Garcinia* species that are often consumed as fresh fruit, the pharmacological profile of *G. cowa* is uniquely concentrated during the drying process, which stabilizes certain organic acids and polyphenolic compounds [13].

2.2. Phytochemical Profile: The Role of (–)-Hydroxycitric Acid (HCA)

The most significant chemical constituent of *Garcinia cowa* is (–)-hydroxycitric acid (HCA), which is localized primarily in the fruit rinds. HCA is a derivative of citric acid and serves as the primary driver for the plant's anti-obesity effects [4]. Literature indicates that HCA content in *G. cowa* can range from 20% to 30% of the dry weight, depending on the maturity of the fruit and the extraction method employed [8]. Beyond HCA, the plant is a prolific source of xanthones—specifically cowanin, cowanol, and cowaxanthone which are rarely found in bovine-centric diets and offer high bioavailability in the human gut [7, 14].

2.3. Anti-Obesity Mechanisms and Lipid Metabolism

The anti-obesity efficacy of *Asam Kandis* operates through the competitive inhibition of the enzyme ATP-citrate lyase [15]. Under normal metabolic conditions, this enzyme facilitates the conversion of citrate into acetyl-CoA, a critical precursor for fatty acid, cholesterol, and triglyceride synthesis. By blocking this pathway, *G. cowa* extracts divert metabolic precursors toward glycogen synthesis in the liver, which subsequently triggers satiety signals to the brain, reducing overall caloric intake [8, 16]. Furthermore,

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recent studies in high-fat diet (HFD) models have shown that HCA from *G. cowa* upregulates the expression of fat-burning genes and improves lipid profiles by reducing Low-Density Lipoprotein (LDL) and increasing High-Density Lipoprotein (HDL) levels [15, 17].

2.4. Antioxidant Capacity and Polyphenolic Synergy

The antioxidant potential of *G. cowa* is attributed to its diverse array of phenolic compounds and flavonoids. Research utilizing DPPH (2,2-diphenyl-1-picrylhydrazyl) and ABTS radical scavenging assays has demonstrated that *Asam Kandis* extracts possess a higher antioxidant IC50 value compared to many commercial synthetic antioxidants [9, 11]. The presence of morelloflavone, a biflavonoid found in the fruit and leaves, has been shown to mitigate oxidative stress at the cellular level by neutralizing reactive oxygen species (ROS). This antioxidant synergy is vital in preventing the chronic inflammation often associated with adipose tissue expansion in obese individuals [18].

2.5. Comparative Efficacy and Safety Standards

While *Garcinia cambogia* has dominated the global supplement market, comparative studies suggest that *Garcinia cowa* may offer a more stable phytochemical matrix for long-term storage [10]. Toxicological evaluations of *G. cowa* extracts in animal models have reported no significant adverse effects on hepatic or renal functions at therapeutic doses, suggesting a high safety margin for human consumption [2, 19]. However, the literature emphasizes the need for standardized extraction protocols to ensure consistent HCA concentrations in commercial functional food products [13, 20].

3. Methodology

3.1. Study Design

This study utilized a Systematic Literature Review (SLR) approach to evaluate the nutraceutical potential of *Garcinia cowa*. The methodology was designed to synthesize qualitative and quantitative data regarding its phytochemical constituents, antioxidant capacity, and anti-obesity mechanisms. To ensure academic rigor and minimize bias, the review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [21].

3.2. Search Strategy and Information Sources

A comprehensive literature search was executed across several high-impact multidisciplinary databases, including ScienceDirect, Scopus, PubMed, Web of Science, and Google Scholar. The search was conducted using specific Boolean operators and keywords: ("Garcinia cowa" OR "Asam Kandis") AND ("anti-obesity" OR "hydroxycitric acid" OR "HCA") AND ("antioxidant" OR "polyphenols"). The scope of the search was primarily focused on peer-reviewed articles published between 2014 and 2024 to ensure the inclusion of contemporary pharmacological findings.

3.3. Inclusion and Exclusion Criteria

To maintain the quality of the data synthesized, the following criteria were applied:

1. Inclusion Criteria: (a) Original research and review articles focusing on *Garcinia cowa* Roxb.; (b) Studies providing quantitative data on HCA concentrations; (c) In vitro, in vivo, or clinical trials investigating lipid metabolism and radical scavenging activities; (d) Articles specifically discussing its use in the Minangkabau or Southeast Asian context.

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2. Exclusion Criteria: (a) Studies focusing exclusively on other *Garcinia* species (e.g., *G. mangostana* or *G. cambogia*) without comparative data to *G. cowa*; (b) Non-peer-reviewed sources such as blog posts or newspaper articles; (c) Studies published in languages other than English or Indonesian.

3.4. Data Extraction and Quality Assessment

Data were systematically extracted and categorized into three thematic clusters:

1. Phytochemical Cluster: Focusing on HCA percentages, xanthone identification, and flavonoid profiles [22].
2. Biological Cluster: Evaluating IC50 values in antioxidant assays (DPPH/ABTS) and weight reduction metrics in animal or human models [23].
3. Culinary-Technological Cluster: Analyzing the impact of traditional drying and cooking processes on the stability of bioactive compounds.

3.5. Data Synthesis

A narrative synthesis was performed to integrate the findings. Quantitative data, such as HCA content and antioxidant inhibition percentages, were tabulated to establish a standardized nutraceutical baseline. The relationship between the traditional use of *Asam Kandis* in Minangkabau cuisine and its observed pharmacological effects was critically analyzed to provide a holistic view of its potential as a functional food [24].

4. Results and Discussion

4.1. Quantitative Phytochemical Profile and HCA Content

The systematic analysis reveals that the fruit rinds of *Garcinia cowa* (Asam Kandis) serve as a highly concentrated reservoir of (–)-hydroxycitric acid (HCA). Data synthesized from multiple chromatographic studies indicate that the HCA content in sun-dried *G. cowa* rinds ranges from 15.4% to 30.2% of the dry weight [12, 17]. This concentration is competitive with *Garcinia cambogia*, which is globally marketed as a weight-loss supplement.

Table 1. Phytochemical composition and biological functions of bioactive compounds isolated from *Garcinia cowa* (Asam Kandis).

Bioactive Compound	Concentration/Range	Biological Function
(–)-Hydroxycitric Acid (HCA)	15.4% – 30.2% (dry weight)	ATP-citrate lyase inhibition; Lipogenesis suppression
Total Phenolic Content (TPC)	45.3 – 112.5 mg GAE/g	Radical scavenging; Cellular protection
Total Flavonoid Content (TFC)	12.8 – 35.4 mg QE/g	Anti-inflammatory; Modulation of enzyme activity
Xanthones (Cowanin, Cowanol)	Significant traces in bark/rind	Cytotoxic activity; Antimicrobial properties

The variability in HCA levels is primarily influenced by the maturity of the fruit at harvest and the traditional drying process used in West Sumatra. Spontaneous sun-drying, while traditional, promotes a gradual reduction in moisture that stabilizes the HCA lactone form, ensuring the retention of its biological activity during long-term storage in Minangkabau households [22].

4.2. Mechanisms of Anti-Obesity and Lipid Modulation

The anti-obesity efficacy of *Asam Kandis* is driven by its ability to modulate the de novo lipogenesis pathway. HCA acts as a competitive inhibitor of ATP-citrate lyase, the enzyme responsible for converting extramitochondrial citrate into acetyl-CoA and oxaloacetate. By restricting the availability of acetyl-CoA, *G. cowa* extract effectively suppresses the synthesis of fatty acids and cholesterol.

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Research in animal models (High-Fat Diet induced) demonstrated that administration of *G. cowa* extract resulted in:

1. Reduction in Adipose Tissue: A significant decrease in visceral fat accumulation compared to the control group [17].
2. Appetite Suppression: Increased synthesis of hepatic glycogen, which sends satiety signals to the ventromedial hypothalamus, thereby reducing caloric intake [16].
3. Improved Lipid Profiles: A recorded reduction in serum triglycerides and Low-Density Lipoprotein (LDL), coupled with a marginal increase in High-Density Lipoprotein (HDL) [18].

4.3. Antioxidant Synergy and Radical Scavenging Activity

Beyond weight management, *G. cowa* exhibits potent antioxidant properties. The presence of biflavonoids, specifically morelloflavone, provides a synergistic effect in neutralizing free radicals. Evaluation using the DPPH assay shows that *Asam Kandis* extracts achieve an IC50 value ranging from 25.4 to 48.2 µg/mL, indicating strong antioxidant capacity comparable to ascorbic acid [9, 11].
This high antioxidant activity is crucial in the context of Minangkabau cuisine, which often involves high-temperature cooking (e.g., *Rendang*). The inclusion of *Asam Kandis* may act as a heat-stable antioxidant, mitigating the formation of lipid peroxidation products during the long cooking process and enhancing the overall nutraceutical value of the dish.

4.4. Cultural Integration and Functional Food Potential
The integration of *Asam Kandis* into daily Minangkabau nutrition provides a unique model for "gastronomic medicine." Unlike encapsulated supplements, the consumption of *G. cowa* as a culinary ingredient ensures a low-dose, consistent intake of HCA and polyphenols.
However, the transition to a global functional food requires modernization. The study identifies that:

- Standardization: There is a need to standardize the drying process to ensure a consistent HCA threshold of >20%.
- Extraction Innovation: Solvent-free extraction methods (e.g., supercritical fluid extraction) could produce high-purity HCA for the pharmaceutical industry.
- Diversification: *Asam Kandis* extracts could be developed into functional beverages, effervescent tablets, or natural food preservatives, leveraging its dual role as an acidulant and an antioxidant.

5. Conclusion

This systematic review establishes *Garcinia cowa* Roxb., or *Asam Kandis*, as a high-value nutraceutical asset within the Minangkabau culinary tradition of West Sumatra. The findings confirm that the fruit rinds possess a formidable phytochemical matrix, dominated by (–)-hydroxycitric acid (HCA) with concentrations ranging from 15.4% to 30.2%. The biological efficacy of *G. cowa* as an anti-obesity agent is substantiated by its capacity to inhibit ATP-citrate lyase, thereby effectively modulating de novo lipogenesis and improving systemic lipid profiles. Furthermore, the synergistic presence of xanthones and biflavonoids, such as morelloflavone, grants this species potent antioxidant properties that exceed those of many commercial synthetic alternatives.
The integration of *Asam Kandis* into daily Minangkabau gastronomy serves as a practical model for the consumption of functional foods, providing long-term metabolic and oxidative protection through culinary application. However, to elevate *G. cowa* from a regional ethnic ingredient to a standardized global functional food, future efforts must focus on the industrial standardization of HCA extraction and the development of modern delivery systems to enhance bioavailability. This study concludes that *Garcinia cowa* holds significant strategic potential in the global wellness market, offering a natural, safe, and culturally enriched intervention for the management of obesity and oxidative stress-related disorders.

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