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REVIEW

A scoping review: Potential nutraceutical values of bioactive compounds and antioxidant activity in durian seed – An exotic tropical plant

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Abstract

Background: Durian is a tropical fruit with a unique flavour and intense aroma. All parts of durian are reported to have many health benefits, especially the seeds. The seeds are known to have higher antioxidant activity and phytochemical compound than the pulp. Durian seeds are food waste that has the potential to be reused in the food and health industry.
Objective: This article provides information on the presence of bioactive compounds, antioxidant activity, and the potential use of durian seeds as therapeutic agents.
Methods: The study used a *scoping* review with four databases: Google *Scholar*, PubMed, DOAJ, and *ScienceDirect. Scoping* is needed to complete the article, summarize scientific data, and as a future reference regarding the nutraceutical potential of durian seeds.
Results: A total of 6 articles were reviewed based on the screening results. The bioactive compounds found in these articles are phenolics, flavonoids, α-tocopherol, terpenoids, saponins, anthraquinones, and several flavonoid classes such as catechin, rutin, isoquercitrin, quercitrin. Total phenolic content (TPC) and antioxidant activity were highest in the Chanee durian seed cultivar compared to the Monthong type and various other cultivars from several countries.
Conclusion: Durian seeds as food waste seem to have potential as a nutraceutical. Known as food waste that is rarely utilized, based on several studies, durian seeds have several benefits, one of which is to overcome various diseases. Further research needs to be done to prove that durian seeds can be helpful in the food industry as well as in pharmaceutical and cosmetic applications.

Keywords: antioxidant activity, bioactive compounds, durian seed, nutritional value

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Introduction

Durian known as *"The King of Fruits"* in Southeast Asia, is a Bombaceae plant that thrives in Southeast

Asia, including Indonesia.[1] Durian is a tropical plant with a unique taste and intense aroma. It is delicious and has potential in the health and food industry.[2,3] All parts of the durian plant, such as the pulp, leaves, outer skin, inner skin, and seeds, are believed to have potential and have many health benefits.[1]

Durian is an annual plant with tree height reaching 25-50 m. Durian trees are brown.[18] In plant systematics (taxonomy), durian is classified as follows.[9]

Kingdom	: Plantae
Subkingdom	: Tracheobionta
Super Division	: Spermatophyta
Division	: Magnoliophyta
Class	: Magnoliopsida
Super Order	: Rosanae
Order	: Malvales
Family	: Bombacaceae
Subfamily	: Helicteroidee
Genus	: Durio
Species	: (Durio ziberthinus)

In addition to being a delicious fruit, various components of durian can also be utilized for various purposes.[18] The creamy white, yellowish, pink, or orange flesh of durian is the most commonly consumed part of the fruit. It is rich in vitamins, minerals, phytonutrients, water, protein, and dietary fiber.[19] Durian seeds are shaped like a chestnut and can be roasted or boiled for consumption. Durian seeds are a good source of nutrients and minerals such as calcium and zinc. Durian peels contain various phytochemical compounds, including phenolic acids, phenolic glycosides, flavonoids, coumarins, triterpenes, and simple sugars.[9] The antioxidant and anti-inflammatory activities of durian pulp, seed, and peel extracts have been investigated, with results showing that durian seed extracts have the most effective antioxidant activity.[2]

One part of durian waste that has yet to be widely utilized is the seed.[7] Seeds are inside the edible pulp and covered with thin, light brown skin, shaped like a chestnut, and can be roasted or boiled for consumption.[5] Durian seeds are essential to develop because only 30% of the consumable part of the durian fruit is edible. At the same time, the rest is the inedible part, including 20-25% of the durian fruit, which consists of seeds.[6] 100 g of durian seed flour contains 8.97 g protein, 0.52 g fat, 75.27 g carbohydrate, and 21.54 g fiber.[7] Research reports that flour made from durian seeds can be used as a substitute for wheat flour in making cakes and cookies.[7,8]

Durian seeds contain good nutrients, minerals, and various phytochemical compounds, including phenolic acids, phenolic glycosides, flavonoids, coumarins, triterpenoids, and simple sugars.[9]

Durian seeds' antioxidant and anti-inflammatory activities showed the most effective antioxidant activity among other parts.[2] Several studies reported that the highest amount of antioxidant activity and content of phytochemical compounds are found in the inedible parts, such as the seeds and skin of durian, compared to the pulp.[10] The nutritional content and bioactive compounds in durian seeds are reported to act as antioxidants, antidiabetics, anti-inflammatory, and anticancer.[11,12]

This literature review was conducted to gather scientific information related to bioactive compounds and antioxidant activity from studies that have been conducted related to durian seeds. This article will help provide a summary of which cultivars and compounds can be studied further to determine the properties of their bioactive components and provide information related to the potential utilization of durian seeds as a nutraceutical that can be applied in the food and pharmaceutical industries.

Methods

The research was conducted by tracing related scientific articles through *literature* studies with a *scoping review* method that refers to the Arskey and O'Malley framework.[13] The literature review search protocol uses the PRISMA *checklist* table to select studies determined and adjusted to the study objectives. The *checklist* begins with identification and screening based on duplication, title suitability, and abstract article type. The article search used a combination of keywords, namely "Durian seed," "*Durio zibethinus* seed," "*Durio zibethinus*,"

"Bioactive compounds," "Antioxidant activity," "Nutraceutical" and *Boolean operations* (AND, OR, and NOT) which were used to expand or minimize the search to facilitate the determination of articles that were following the study objectives. Article identification was made by searching data using several databases: Google Scholar, PubMed, DOAJ, and ScienceDirect and then followed by screening articles based on inclusion criteria, namely English articles, full text according to IMRAD, focused on nutraceuticals of durian seed and designed by analytic quantitative and randomized controlled trial (RCT), published from 2015-2024, indexed by Scopus, DOAJ, Sinta, and Google Scholar. Exclusion criteria in this article are incomplete articles (IMRAD), not reputable, published before 2015, and focused on topics other than durian seeds, such as skin, ripe, leaves, roots, and others. These criteria are different from the research objectives and can make the article lack novelty.

Results

Source of evidence

The results of the article search resulted in a total of 1027 related articles. As shown in Figure 1, the search was carried out using four databases: Google Scholar had 883 articles, ScienceDirect 106 articles, PubMed 17 articles, and DOAJ as many as 21 articles. The next stage, selecting search results from the four databases, was carried out by identifying and screening the article titles one by one while reading the abstract, ensuring that the article was not a review article and duplication so that 16 relevant articles were produced. The next stage, 16 relevant articles were selected based on the inclusion criteria. The final results of the selection found six articles with full criteria per the study objectives that lead to the bioactive content and antioxidant activity of durian seeds. Finally, these six articles will be used in this review study. Details of the justification for screening the articles can be seen through the PRISMA flow chart in **Figure 1**.

Characteristics and synthesis of selected articles

Figure 1. shows that six scientific articles meet the selection criteria and will be reviewed further in this article review. Based on the screening results of the six articles, they have a quantitative design research design with experimental methods that show the amounts of bioactive components and antioxidant activity of durian seeds with nutraceutical potential through various test methods. These articles come from countries like Thailand, the Philippines, and China. After identifying and screening many articles, the selected articles investigated the bioactive components and antioxidant activity of durian seeds, which are reported to have therapeutic effects on various diseases.

Based on the six filtered articles, (1) The study investigated the effect of the addition of durian seed extract on the content of bioactive components and antioxidant activity in cosmetic products using the DPPH method and quantitative phytochemical compounds, (2) This study investigated the effect of durian seed extract on the content of bioactive components and antioxidant activity in cosmetic products. (3) This study from Thailand investigated the total phenolic content and antioxidant activity of Monthong and Chanee durian seeds with various tests such as ABTS, NO, superoxide, hydroxyl radical, and metal ion. (4) This study examines the content of bioactive compounds from durian seed oil; (5) Research investigates the content of bioactive compounds in durian seeds and antioxidant activity; (6) The last article examines the content of bioactive components, namely total phenolics and polyphenols and antioxidant activity tests through FRAP, DPPH and ABTS methods.

This review found that durian seed extract contains bioactive compounds with antioxidant properties, such as phenolics, saponins, anthraquinones, terpenoids, and flavonoids, as well as several flavonoid derivatives, which could be potential nutraceuticals with benefits for treating diabetes and dyslipidemia. The summarized findings of the articles are shown in **Table 1**.

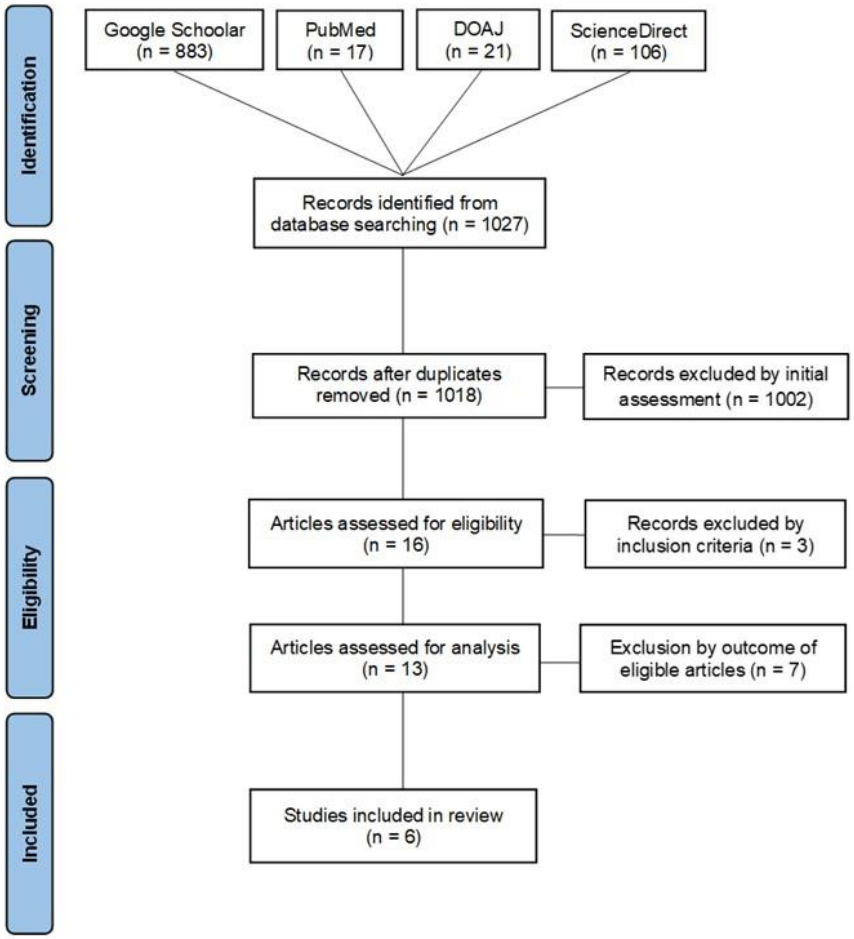

Figure 1. PRISMA flow chart

Table 1. Article summary

Source	Country	Study Assays	Result	
			Bioactive components	Antioxidant activity
Mungmai *et al.*, 2023.[14]	Thailand	Bioactive compounds: Total phenolics (Folin- Ciocalteu assay), flavonoids (Shinoda assay), tannins (ferric chloride assay), triterpenoids, steroids (The Liebermann- Burchard assay), alkaloids (The Mayer assay), and the carbohydrates (Molisch test) Antioxidant activity: - DPPH	- Durian seeds (S): Flavonoids, steroids and tannins - TPC of durian seeds: 0.33 ± 0.01 mg gallic acid/g - Tannins, triterpenoids, alkaloids and carbohydrates	DPPH: durian seed extract IC50: 0.08 ± 0.00 mg/ml) IC50: 80 ± 0.00 µg/mL
Juarah *et al.*, 2021.[10]	Malaysia	Bioactive compounds: Total phenolics (Folin- Ciocalteu assay), flavonoids (colorimetric assay) Antioxidant activity: FRAP, DPPH, ABTS	Total phenolic content of durian seed extract Sukang durian seeds (SS): 88.70 mg GAE/g Topoloh durian seeds (TS):143.60 mg GAE/g Total flavonoids from durian seed extract Sukang durian seeds: 193.50 mg GAE/g Topoloh durian seeds: 165.80 mg GAE/g	IC_{50} DPPH: - (SS): 27.87 ± 0.45 µg/ml - (TS): 20.37 ± 0.40 µg/ml IC_{50} ABTS: - (SS): 16.43 ± 1.40 µg/ml - (TS): 10.00 ± 0.60 µg/ml FRAP - (SS): 186.20 µg/ml - (TS): 297.90 µg/ml
Charoenphun and Klangbud, 2022.[2]	Thailand	Bioactive compounds: gallic acid-TPC standards Antioxidant activity: ABTS, NO, superoxide, hydroxyl radical, metal ion	Total phenolic content of durian seed extract: Monthong seed (MS): 4210.98 ± 15.40 mg GAE/g Chanee seed (CS): 4974.51 ± 60.85 mg GAE/g	ABTS: MS (13.85 ± 6.06 µg/mL); CS (6.83 ± 0.19 µg/ml) NO: MS (57.08 ± 16.31 µg/ml); CS (256.30 ± 135.40 µg/ml) Superoxide: MS (88.55 ± 7.97 µg/ml); CS (167.90 ± 14.95 µg/ml) Hydroxyl radical: MS (2.28 ± 0.22 µg/ml); CS (101.90 ± 3.50 µg/ml) Metal ion: MS (90.77 ± 30.08 µg/ml); CS (53.60 ± 2.70 µg/ml)
Desa *et al.*, 2016.[15]	Malaysia	Bioactive compounds: seed oil: Soxhlet extraction (SE)	- α-tocopherol: 9.093 ± 0.71 µg/L - TPC: 0.5 ± 0.09 mg GAE/g	-

Source	Country	Study Assays	Result	
			Bioactive components	Antioxidant activity
		Total phenolic (Folin- Ciocalteu assay) Flavonoids (Aluminum chloride Colorimetric test) α-tocopherol content (HPLC)	- TFC: 0.39 ± 0.32 mg QE/g dry plant	
Gabule *et al.*, 2018.[16]	Philippines	Bioactive compounds: alkaloids, phenols, anthraquinones, tannins, flavonoids, saponins, terpenoids Thin-layer test Chromatography (TLC) Antioxidant activity: - DPPH	- Durian seeds contain phenols, saponins, anthraquinones, flavonoids, and terpenoids.	- DPPH: durian seed extract (IC50 = 44.17 mg/L)
Chen *et al.*, 2016.[17]	China	Bioactive compounds: Total phenolic (Folin- Ciocalteu assay), polyphenol (UPLC analysis) Antioxidant activity: FRAP, DPPH, ABTS	- TPC: 7.26 ± 0.23 mg GAE/g - Rutin: 151.93 ± 0.13 µg/g - Isoquercitrin: 164.57 ± 0.5 µg/g - Quercitrin 160.45 ± 13.06 µg/g	- FRAP: 11.50 ± 1.19 µmol Trolox/g - DPPH: 39.77 ± 0.85 µmol Trolox/g - ABTS: 41.34 ± 0.85µmol Trolox/g

Note: DPPH(2,2-diphenyl-1-picrylhydrazyl,); TPC (Total Phenolic Content); TFC (Total Flavonoid Content); ABTS (2,2'-Azino-bis (3-ethylbenzothiazoline-6-sulfonic acid); FRAP (Ferric Reducing Antioxidant Power); NO (Nitrit oxidase); GAE (Gallac acid equivalent); QE (Quercetin equivalent); UPLC (Ultra-Performance Liquid Chromatography); HPLC (High-Performance Liquid Chromatography).

Discussion

Indonesia has eight candidates of exotic fruits with high annual productivity, such as mango, orange, snake fruit, papaya, durian, jackfruit, rambutan, and avocado.[20] The seeds of those fruits are reported to have many nutrients, bioactive compounds and offer great potential as primary sources of nutracueticals foods. In this literature review, 5 out of 6 articles discuss the content of bioactive compounds in durian seeds. The most bioactive components found in this study are total phenolics and flavonoids. Based on the results of the review, Chanee durian seeds have the highest total phenolic content compared to other types, such as Monthong, Topoloh, Sukang, and local Philippine durian, with consecutive totals can be seen in Table 1.[2] Meanwhile, the highest total flavonoids are found in Sukang durian seeds from Sabah Island compared to Topoloh and other types.[10]

Phenolics and flavonoids are a class of polyphenols found in durian seeds in this study. Phenolic and flavonoids are known as compounds that have potential for human health.[24] A study conducted on T2DM rats showed that phenolic compounds are antioxidant agents that can prevent and inhibit the formation of free radicals, thereby suppressing oxidative stress and helping to prevent the formation of free radicals, improving elevated blood glucose.[25] Therefore, the phenolic content in durian seeds is expected to improve human health by suppressing oxidative stress that triggers degenerative diseases.[26]

In addition, in this study durian seeds contained flavonoid class compounds, namely rutin, isoquercitrin, and quercitrin. The flavonoid has various properties such as lowering blood pressure, anti-hyperlipidemia, anti-hyperglycemia, antioxidant, antiviral, anticancer, anti-inflammatory, anti-microbial, neuroprotective, and cardioprotective effects.[28] Flavonoid classes plays a role in managing metabolic disorders by increasing adiponectin, reducing leptin and antioxidant activity, reducing insulin resistance, and increasing insulin levels.[29] A review article states that quercetin supplementation as one of sub-class of flavonoids plays a good role in patients with diabetes, rheumatoid arthritis, hepatitis, hypercholesterolemia, hypertension, and cardiovascular disease.[20] Other than quercetin, rutin is a natural flavonoid that found in durian seed have antioxidant and anti-inflammatory properties that help improve blood circulation, reduce inflammation, and strengthen blood vessels.[30] The antihyperglycemic mechanism of rutin plays a role in reducing carbohydrate absorption from the small intestine, inhibiting tissue gluconeogenesis, increasing tissue glucose absorption, stimulating insulin secretion from beta cells, and protecting the islets of Langerhans against degeneration.[31] In line with research in 2020, the administration of durian seed extract can reduce blood glucose levels in rats induced diabetes mellitus type 2.[32,37]

In addition to flavonoids and phenolics, durian seeds have also been shown to contain alkaloid and triterpenoid antioxidants.[16] Alkaloid compounds will regenerate cells by restoring partially damaged pancreatic cells, enabling them to function as antioxidants by combating free radicals and regenerating pancreatic cells through the mechanics of repair and protection of damaged pancreatic beta cells.[33] Triterpenoids found in durian seeds may contribute to lipid metabolism and adipocyte function alongside alkaloids. Triterpenoids can regulate the activity of specific genes responsible for lipid metabolism, including PPARγ and SREBP-1c. These genes play a crucial role in the development of fat cells and the production of lipids.[34] Furthermore, triterpenoids can stimulate AMP-activated protein kinase (AMPK), which acts as a cellular energy sensor and controls lipid metabolism. AMPK activation enhances lipolysis by promoting the breakdown of triglycerides into free fatty acids and glycerol.[35] In general, triterpenoids can influence the breakdown of fats by regulating the expression of genes involved in lipid metabolism, preventing the formation of fat cells, and activating AMPK.[34,36] These phytochemical substances are anticipated to enhance the state of degenerative diseases.[19]

In several in-vivo studies, the intervention of durian has many benefits, including antihyperglycemic and anti-hypercholesterolemia in rat models.[37,38] The intervention of durian seed extract ointment can accelerate wound healing in

rats with excision wounds, prolong epithelialization time, increase collagen deposition, and stimulate fibroblast cell proliferation.[11,39] Other in vitro studies report that the aqueous and ethanol extracts of durian seed coat have inhibitory effects on the growth of HSV-2 *(Herpes Simplex Virus Type 2)*. The durian seed extract has a better inhibition percentage than the aqueous extract.[12] These studies proved that durian seeds have been confirmed as a potential antioxidant food ingredient and restored its promising position in the region as an effective traditional medicine.[37,40]

Based on the results, durian seeds also have potent antioxidant activity. 4 out of 5 articles tested antioxidant activity shows that Topoloh durian seeds from Sabah Island have the highest antioxidant activity compared to Sukang, Monthong, and local durian species of the Philippines and Malaysia using the DPPH- radical test with an IC50 value of 20.37 ± 0.40 µg/ml.[10] Through the ABTS test, Chanee durian seeds have higher antioxidant activity than Monthong, Sukang, Topoloh, and other local durians with IC50 ABTS value of 6.83 ± 0.19 µg/mL. The IC50 value is defined as the concentration of antioxidant compounds needed to reduce free radical activity by 50%, whereas the more minor the IC50 value, is the higher the antioxidant activity.[22] A study also found that durian seed extract from Indonesia has high antioxidant activity through the DPPH test with an IC50 value of 23.10 µg/ml. [24]

All of the articles that discuss antioxidant activity and bioactive components in durian seeds of various cultivars reveal that in addition to total phenolics and flavonoids, through phytochemical screening, durian seeds also contain compounds such as α-tocopherol, carbohydrates, steroids, triterpenoids, tannins, alkaloids, saponins, terpenoids, anthraquinones, and flavonoids such as rutin, isoquercitrin, and quercitrin.[16,18] They have been found to contain medicinal properties, such as potential in anti-inflammatory and antidiabetic. This article can be used as reading material and further research to prove that durian seeds can be used as food waste that has nutraceutical potential.

The limitation of this scoping review: First, the article review only applies to articles written in English. Second, this study only identified four databases, and many articles needed to meet the standards. Third, the available sources related to durian seeds still need to be studied, especially the quantity of bioactive components in durian seeds. The strength of this study comes from reliable sources and filtering articles by selecting only the best articles that meet the inclusion and exclusion criteria to ensure that the articles found are relevant to the objectives of this study.

Conclusion

In conclusion, durian seeds of different species contain many bioactive components such as phenolics, tocopherols, terpenoids, saponins, anthraquinones, flavonoids, and many more and show high antioxidant activity through various test methods such as FRAP, DPPH, ABTS, NO, superoxide, hydroxyl radicals, and metal ions. Durian seeds have been reported to contain therapeutic properties for various diseases with anti-inflammatory, antioxidant, and antidiabetic roles. This scoping review has summarized various literature related to the content of bioactive components and antioxidant activity in durian seeds. Further research in the future on the efficacy of durian seeds in diabetes mellitus, dyslipidemia, hypertension, or metabolic syndrome. This article is expected to be a source of relevant and helpful literature for future research related to durian seeds.

Further research is needed so that durian seeds can be considered therapy to decrease insulin resistance and fasting blood glucose levels in patients with metabolic syndrome. Durian seeds can also be developed as supplements or processed products with high economic value.

Conflict of interest

The authors declared no conflict of interest regarding this article.

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