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Mapping review of the potential of Tarap Plants (Artocarpus odoratissimus) for health

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Abstract---Artocarpus odoratissimus (A. odoratissimus), or tarap fruit in Indonesian, is widely used as traditional medicine because almost all parts have pharmacological properties. The purpose of this review is to examine the health benefits of tarap plants based on published evidence, and also to find out where the potential for these compounds is stored in plant parts. Based on the results of the review, the parts that have the potential as antioxidants are the peel, seeds and flesh of the fruit. The peel also has antidiabetic and anticancer functions. The seeds have an antibacterial function.

Keywords---*Artocarpus odoratissimus,* Tarap, antioxidant, antidiabetic, anticancer.

Introduction

Artocarpus odoratissimus (A. odoratissimus), or known as tarap fruit in Indonesian, is a plant native to the Indonesian island of Borneo and spread to Sabah, Sarawak and Brunei Darussalam. The fruit is considered superior in taste

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compared to jackfruit or cempedak, the flesh has a distinctive, sweet aroma, the roasted seeds have a hard, nutty texture, and are not too oily. The taxonomy of plants is as follows: Kingdom: Plantae. Division: Magnoliophyta. Class: Magnoliopsida. Family: Moraceae. Species: Artocarpus (Abu Bakar & Abu Bakar 2018).

Artocarpus includes about 50 species of trees. The name comes from two Greek words, "artos" and "karpus," (Hari et al. 2014). Almost all parts of the genus Artocarpus have pharmacological properties and are widely used as traditional medicine for diabetes, diarrhea, malaria, and tapeworm infections. (Jagtap & Bapat 2010). In addition, by local people in Sarawak, the ash from the applied leaves is used as an antidote to the stings of centipedes and scorpions by applying the ashes from the leaves to the wound, while for the treatment of scabies, ash is added with a little coconut oil.(Nyokat et al. 2017; Hussain et al. 2021).

Artocarpus species are also rich in phenolic compounds, including *flavonoids, stilbenoids* and *arylbenzofurones*. (Hakim et al. 2007). Phytochemical studies conducted on the root extract of Artocarpus odoratissimus succeeded in isolating two flavonoid compounds, namely *pinocembrin* and *pinostrobin. Pinocembrin* has antioxidant, antimicrobial, anti-inflammatory, antibacterial, antifungal, and anticancer activities. *Pinocembrin* has potential as a drug to treat cerebral ischemia, neurodegenerative diseases, cardiovascular diseases and atherosclerosis and plays an important role in the prevention and cure of various neurodegenerative diseases, such as Alzheimer's disease, Parkinson's disease and other neurological dysfunctions. (Liu et al. 2014; Drewes & van Vuuren 2008; Essa et al. 2012).

Pinostrobin is a flavonoid inducer. *Pinostrobin* isolated from *Polygonum lapathifolium* nodosum can rapidly provide an intensive apoptotic response to stimulate leukemia cells in vitro. So that it can be an excellent alternative for leukemia chemoprevention agents, *pinostrobin* also has anticancer activity against fibrosarcoma cancer by its mode of action which causes gradual leakage, envelope damage and viral inactivation. (Smolarz et al. 2006; Oka Adi Parwata, Sukardiman 2014; Wu et al. 2011).

From the various possible benefits of tarap plants that have been reported based on the compounds found, the authors are interested in reviewing the benefits of tarap plants for health based on published evidence, and also knowing where the potential for these compounds is stored in plant parts. The author will do a mapping based on the usefulness and potential of the various compounds found.

Methods

This review was conducted by browsing the journal databases as follows: Google Scholar, Pubmed, and Science Direct. The articles used are articles published between 2000-2022. The keywords and booolean operators used include: “Artocarpus odoratissimus AND Health”, and “Artocarpus odoratissimus AND antioxidant”, and “Artocarpus odoratissimus AND antidiabetic”, and “Artocarpus odoratissimus AND phytochemical properties".

The inclusion criteria are: full paper, open access and non-open access, using English or Indonesian. All filtered articles will be subjected to a critical review and grouping by the writing team for further mapping.

Results and Discussion
Antioxidant potential

Various studies have provided evidence of the potential for tarap plants (A. odoratissimus) to have the highest reducing ability for antioxidant compounds among all plant species, details of the content of antioxidant compounds are in table 1.

Table 1
Antioxidant levels of plant parts

Author	Extraction method	Plant parts	Levels of antioxidant compounds
(Bakar et al. 2015)	FRAP (FERRIC REDUCING/ANTIOXIDANT POWER) ASSAY	- Peel - Flesh - Seed Phenolic - Peel - Flesh - Seed Flavonoid - Peel - Flesh - Seed Carotenoid - Peel - Flesh - Seed	- 378.93±20.25 μM/g - 17.92±0.74 μM/g - 68.06±2.93 μM/g - 42.38±0.20 mg/g - 3.53±0.33 mg/g - 13.72±0.87 mg/g - 36.78±0.28 mg/g - 1.23±0.09 mg/g - 10.18±0.81 mg/g - 0.86±0.04 mg/g - 0.79±0.23 mg/g - 0.67±0.14 mg/g
(C.L. Ee et al. 2010)	MTT assay and ELISA microplate reader.	- Flesh	- IC_{50} value of 32.1 g/ ml (1,1-*diphenyl-2-picrylhydrazyl radical* (DPPH)
(Abu Bakar & Abu Bakar 2018)	FRAP (FERRIC REDUCING/ANTIOXIDANT POWER) ASSAY	- Seed - Peel	- 13.69 mg AEAC/g ± 0.59c - 2.44 mg AEAC/g ± 0.15e Scavenging activity on 2,2-*diphenyl-2-picrylhydrazyl radical*
(Rizki et al. 2021)	2,2-difenil-1-pikrilhidrazil (DPPH)	- Leaf	- IC_{50} value of 87,9513 ppm (ekstrak etanol)
(Ee et al. 2012)	ELISA microplate reader	- Trunk	- Chloroform > 120 IC_{50} (μg/ mL-1 and 1.7 I (%) - Ethyl acetate > 120 IC_{50} (μg/ mL-1

	and 45,1 I (%) - Ethanol > 120 IC_{50} (μg/ mL-1 and 24,1 I (%)

Phenolic acids (*ferulic acid* and *p-coumaric),* are known as strong antioxidants and were detected to have anticancer activity against colon cancer. Another study also detected ferulic acid content in *A. odoratissimus* seeds (444.40 ± 23.13 g/g) while none was detected in meat. (Alkhalidy et al. 2015).

Artocarpus odoratissimus also contains *polyphenolic* compounds such as gallic acid derivatives, ellagic acid and ferulic acid which are promising sources of natural food antioxidants, as well as inhibiting the oxidation of organic molecules in food. (C.L. Ee et al. 2010; Possingham 2008).

Flavonoid compounds are also very important for human health because of their high pharmacological activity as free radical scavengers, antioxidant activity, preventing coronary heart disease, and anticancer activity, while some flavonoids show potential for immunodeficiency in the HIV virus. (Maisuthisakul et al. 2007).

Antidiabetic Potential

Based on the results of research conducted on extracts of the skin, seeds and fruit of A. *odoratissimus*, it was reported that they contain phenols and flavonoids which have the property of inhibiting the activity of the alpha-glucosidase enzyme. The fruit peel extract which made up about 60% of the weight of A. odoratissimus was detected to have the highest levels of phenols and flavonoids (IC_{50} = 48.19 g/mL) compared to the seed extract.(Jonatas et al. 2020). Screening was carried out by taking a chromatographic thin layer with a concentration of 2 to 1000 g/mL from the skin, pulp, and seed extracts. Evaluation for the antidiabetic test was carried out in vitro using the enzyme alpha-glucosidase. From this research, tarap skin, which is usually underutilized and discarded, can actually be a potential source of antidiabetic agents.

Extracts from seeds IC_{50} 51.64 g/mL, pulp IC_{50} 177.8 g/mL and acarbose yielded IC_{50}135.2 g/mL values. The enzyme alpha glucosidase digests carbohydrates and increases postprandial glucose levels among patients with diabetes mellitus. so that the inhibition of this enzyme in vitro can prevent a person from developing diabetes (Parveen et al. 2018; Firdous 2014). The inhibition of the alpha glucosidase enzyme from the highest to the lowest was found in seed extract (98.25 ± 0.16%), followed by fruit pulp extract (96.32 ± 0.08%), then skin extract (95.91 ± 0.16%). 0.08%, and finally, acarbose (76.07 ± 1.64%)(Jonatas et al. 2020).

Anticancer Potential

This research on *Artocarpus* species structurally explains the content of pyranoflavones and triterpenoids. *Pyranoflavones* can be a potential anticancer (C.L. Ee et al. 2010). Our recent study of Artocarpus odoratissimus (Moraceae) has resulted in the purification of the pyranoflavone derivatives artosimmin and traxateryl acetate. Furthermore, the biological assay results showed that compound 1 was significantly cytotoxic against cancer cell lines (HL-60 & MCF-7) and also had antioxidant properties against 1,1-diphenyl-2-picrylhydrazyl radical (DPPH) (C.L. Ee et al. 2010; Duan et al. 2008).

Antibacterial Potential

The antibacterial activity of A. odoratissimus seed extract was evaluated using a diffusion test against MDR (multi drug resistance)-E.coli (MDR-E) bacteria from patients with urinary tract infections (UTI). The antibacterial activity of the seed extract at concentrations of 0.1 mg/mL, 1 mg/mL, 10 mg/mL, and 100 mg/mL was determined by measuring the diameter of the inhibition zone (mm) against five MDR-E.coli isolates. The inhibition zone of A. odoratissimus seed extract against MDR E. coli was 6.0 ± 0.0 mm - 12.5 ± 0.5 mm, while the zone of inhibition against E. coli ATCC 25922 was 9.0 ± 0.7 mm - 14.0 ± 0.7 mm (Prastiyanto 2021).

Two important compounds that provide anticancer effects are flavonoids and tannins. Flavonoids are derivatives of *2-phenyl-benzyl-γ-pyrone* and these compounds are most commonly found in plants because flavonoids are compounds synthesized by plants in response to infection. (Panche et al. 2016). In this study, the inhibitory mechanism of MDR-E. coli by flavonoids from Artocarpus seed extract inhibited DNA gyrase from E.coli by quercetin, apigenin, and 3,6,7,3', 4'– *pentahydroxyflavone* compounds (Prastiyanto 2021). Tannin compounds are reported to interfere with the metabolism of E. coli, in this study the tannin compounds contained in Artocarpus seeds (Dabbaghi et al. 2019; Belhaoues et al. 2020; Prastiyanto 2021).

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