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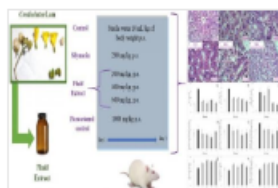
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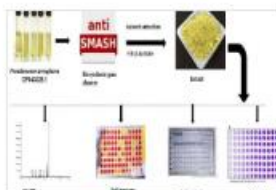
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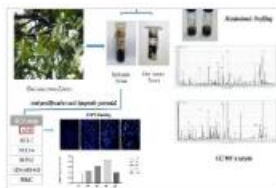
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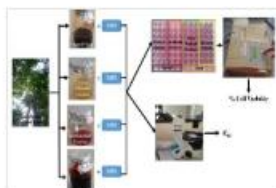
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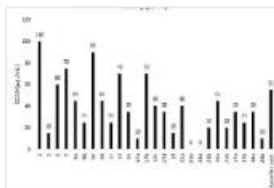
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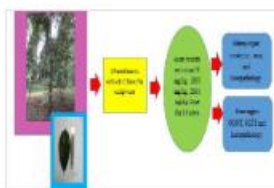
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Sani Nurlaela Fitriansyah, Irda Fidrianny, Rika Hartati



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Pharmacological Activities and Phytochemical Compounds: Overview of Pouteria Genus

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ABSTRACT

Species of Pouteria are widely spread in various countries. Pouteria is one of the genus that have diverse pharmacological activities. This review includes an overview of the species from Pouteria, phytochemical methods used in isolation of compounds from Pouteria, and their pharmacological activities. The trends in the pharmacological activity of Pouteria is antioxidant activity, antidiabetic and antimicrobial activities. However, information on its use as a traditional medicine from Pouteria was poor. Chemical compounds that have been widely isolated from Pouteria genus included phenolic acid, other phenolics non flavonoid, flavonoids, and terpenoids derivative. The most widely reported chemical compounds from Pouteria are terpenoid derivatives. Further research is needed for the mechanism of action based on the pharmacological activities of chemical compounds.

Key words: Pouteria genus, Pharmacological activities, Phytochemical compound.

INTRODUCTION

Pouteria genus in one of the 53 genus.¹ Sapotaceae family, which has 325 species² and distributed in tropical and subtropical region.³ Some species of Pouteria were used as traditional medicine. The experiment of pharmacological activities can be based on a report the use of these plants as traditional medicine and chemical content. Information regarding pharmacological activities and phytochemical compounds of Pouteria genus were needed for developing Pouteria genus uses in pharmacy industries. Therefore, this article reported information concerning pharmacological activities, phytochemical method and chemical compounds of Pouteria genus.

METHOD

The data was collected through PubMed. There are 71 journals in PubMed with keyword Pouteria. Journals that used as literature for this review are classified based on international journals indexed by Scopus, quartile 1-4.

RESULTS

The uses of Pouteria genus as traditional medicine can be shown in Table-1. Several species of Pouteria genus were used as food material. The fruits of Pouteria was often consumed directly^{4,5} and used as an additional ingredient in food such as in pudding.^{6,7} In traditional medicine, *P. ramiflora* as antihyperlipidemic,^{8,9} *P. campechiana*, was used for heart disease, liver, epilepsy, stomach diseases, and skin disruption.¹⁰ Other species of Pouteria genus was applied for inflammation, diabetes, indigestion,^{3,11} diarrhea,¹² nausea, throw up and relieve back pain.¹³ Based on the taxonomy of Pouteria, the most studied species is *P. campechiana*, and it can be seen the order and total species

studies in term of pharmacological activity and the compounds isolated in Figure 1.

Phytochemical Compounds of Pouteria Genus

Secondary metabolites in plants are generally produced through the pathway of shikimic and acetic acid. Secondary metabolites from shikimic pathway are phenylpropanoid, simple phenolic compound and polyphenols including flavonoids. Whereas from the acetic acid pathway it is derivative of terpenoids, sterols and derivative of volatile compounds. In this review, information regarding phytochemical compounds of Pouteria genus up to 2019, was presented in Table 2 and Figure 2. Flavonoid, phenolic compounds and terpenoid were secondary metabolite isolated from Pouteria genus.

Other terpenoid compounds that have isolated included α -amyrin and lupeol. These compounds were found in *P. torta* fruits and flower^{19,20} and *P. caimito* fruits.²¹ Alpha-amyrin acetate and β -amyrin were presented from stem bark extract of *P. tomentosa*,²² *P. Torta*²³ and *P. gardneri* leaves extract.²⁴ Beta-amyrin acetate and betulinic acid were isolated from methanol leaves extract of *P. torta*²³ and *P. tomentosa*.²² Ursolic acid was reported from several species of Pouteria, included *P. venosa* extract,¹¹ *P. gardnerii* extract²⁴ and *P. tomentosa* extract.²² Taraxerol was reported in *P. caimito* extract,^{21,25} and *P. venosa* extract.¹¹ While carotenoids were found in *P. cambodiana* extract.¹²

The other phenolic groups which were isolated from Pouteria, included gallic acid, (+)-gallocatechin, (+)-catechin, (-)-epicatechin, (+)-catechin-3-O-gallate epicatechin, and myricitrin from *P. campechiana*, *P. sapota* and *P. viridis* extracts.³ Myricitrin have been also isolated from *P. torta* extract.²⁰ Stilbenes and *protocatechuic acid* have

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Table 1: The use of Pouteria genus as traditional medicine.

Species	Part of	Uses as traditional medicine	Ref.
<i>Pouteria caimito</i>	Leaves	for antimalaria, reduce pain, and wound healing	14
	Flesh of fruit	to relieve cough, bronchitis, and other lung disorders	15
	Latex	as a laxative	
<i>Pouteria cambodiana</i> (Pierre ex Dubard) Baehni	Stem bark	decoction of stem bark to facilitate breast milk	16
<i>Pouteria ramiflora</i> (Mart.) Radlk	Other parts	for nausea, vomiting, fever and relieve back pain	8,9
	Fruits and root	as anthelmintic, dysentery, and inflammation	
<i>Pouteria campechiana</i> (Kunth) Baehni	Stem bark	antipyretic and for healing injured skin	15, 10, 17
	Peel of fruits	fever reducing medication	
	Leaves	decoction of leaves for diarrhea	
<i>Pouteria sapota</i> (Jacq.) H. E. Moore & Stern	Seed and seed oil	to reduce pain in the ear, to treat kidney stones, rheumatism, and digestive disorder	18

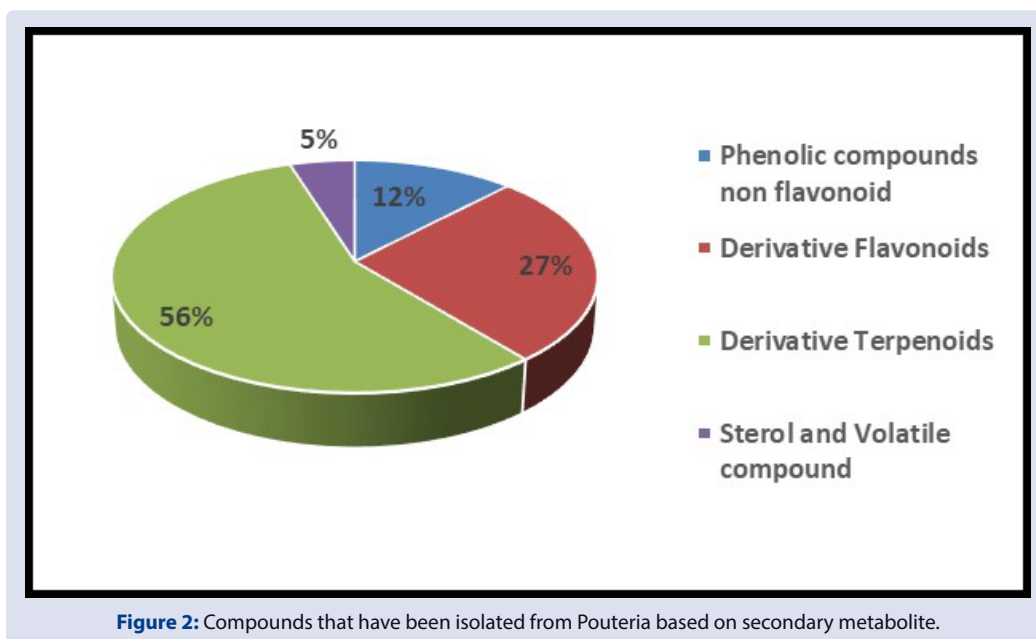
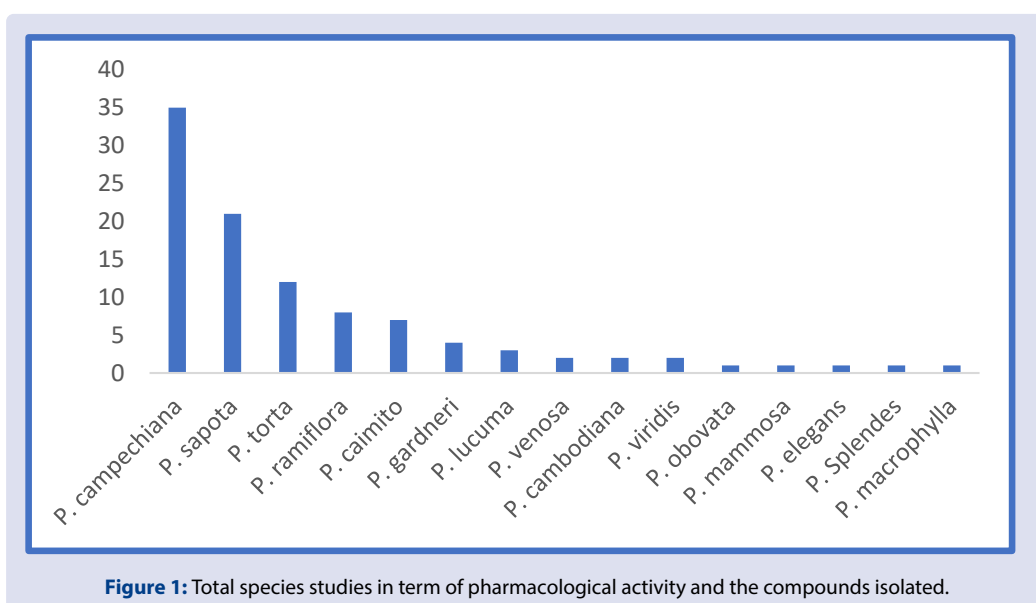


Table 2: Phytochemical compounds of Pouteria up to 2019.

Phytochemical compounds	Species	Part used	Extraction method	Solvent	Ref.
Flavonoid					
Myricetin	<i>P. campechiana</i>	Leaves and seed	Maceration	EtOH 70%	27
	<i>P. torta</i>	Leaves	Percolation	EtOH-Water (7:3)	28
Myricetin-3-O-β-galactoside	<i>P. campechiana</i>	Leaves and seed	Maceration	EtOH 70%	27
Myricetin-3-O-α-L-rhamnoside	<i>P. sapota</i>	Fruits	Soxhlet	EtOH 99%	29
Quercetin	<i>P. campechiana</i>	Leaves; Seed	Maceration	EtOH 70%	27
Quercetin 3-O-α-L-rhamnopyranoside					
Quercetin 3-O-β-arabinopyranoside					
Taxifolin 3-O-α-arabinofuranoside	<i>P. campechiana</i>	Leaves	Maceration	Methanol	30
Trans-taxifolin 3-O-α-arabinopyranoside					
Taxifolin 3-O-α-rhamnopyranoside					
Phenolic ompound					
Gallat acid	<i>P. campechiana</i>	Leaves and Seed	Maceration	Ethanol 70%	27
Terpenoid					
a. Neoxanthin;					
b. (9'Z)-Neoxanthin	<i>P. sapota</i>	Ripe Fruit	Homogenized with acetone	Acetone	31
c. Capsoneoxanthin					
a. α- and β- amyirin					
b. Lupeol	<i>P. gardneri</i>	Leaves	Maceration	n-Hexane	32
c. α-amyirin acetate					
d. Ψ-taraxasterol acetate					
a. ursolic	<i>P. gardneri</i>	Leaves	Maceration	Ethanol	
b. oleanolic acid					
Monoterpene (α-Pinene)	<i>P. elegans</i>	Ripe fruits	HS-SPME technique		33
a. sapotexanthin 5,6-epoxide					
b. sapotexanthin 5,8-epoxide	<i>P. sapota</i>	Ripe fruits	Homogenized in mortar	Acetone	34
c. cryptocapsin					
d. capsanthin 5,6-epoxide					
a. Friedelin	<i>P. ramiflora</i>	Leaves	Maceration	n-Hexane	35
b. Epi-friedelanol	<i>P. ramiflora</i>	Leaves	Maceration	n-Hexane	
	<i>P. venosa</i>	Leaves; bark; stem bark	Maceration	Ethanol	11
Taraxerol					
a. Spinasterol;	<i>P. campechiana</i>	Stem bark	Maceration	Ethyl acetate	36
b. Three triterpenes fatty acid ester					
a. β-cryptoxanthin-5,6-epoxide;					
b. β-cryptoxanthin-5',6'-epoxide;	<i>P. sapota</i>	Fruits	Homoge-nized with NaHCO ₃	Acetone	37
c. 3' Deoxycapsanthi					
d. Cryptocapsin					
a. Cryptocapsin-5,6-epoxide;	<i>P. sapota</i>	Fruits	Homoge-nized with NaHCO ₃	Acetone	38
b. 3'-deoxycapsanthin-5,6 epoxide;					
c. cryptocapsin-5,8-epoxides					
a. 3'-deoxycapsorubin	<i>P. sapota</i>	Fruit	Homoge-nized with NaHCO ₃	Acetone	39
b. 3,3'-dideoxycapsorubin					
Sapotexanthin (all-E,5'R)-β,κ-caroten-6'-one	<i>P. sapota</i>	Fruit	Homoge-nized with NaHCO ₃	Acetone	40

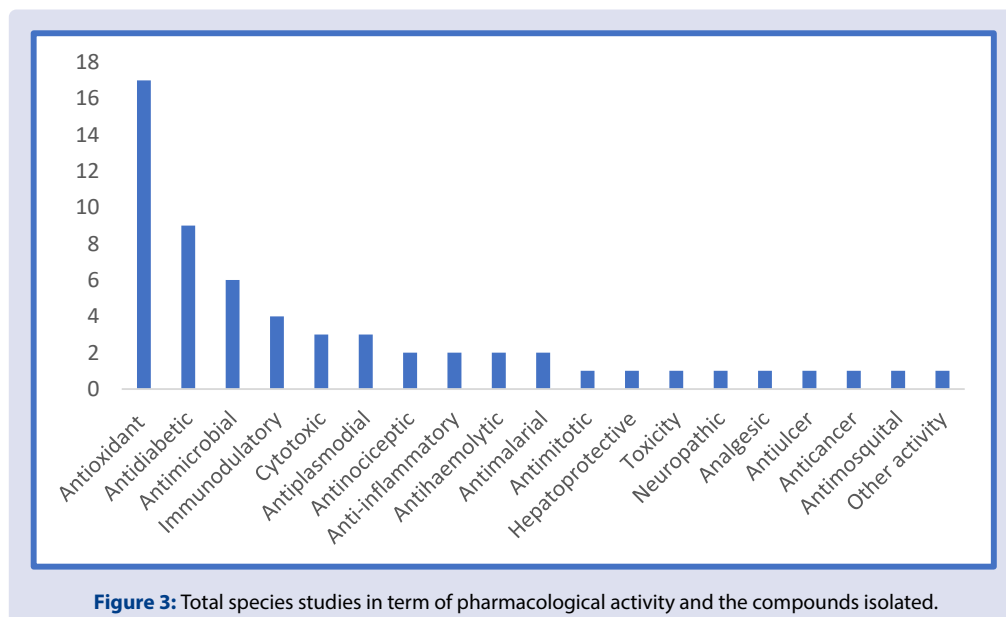
been isolated from *P. cambodiana* extract.^{13,16} Besides that, four of dihydroflavonols (dihydrokaemferol glycosides) were isolated from methanol-water (80:20) extract of *P. obovate*.²⁶

Pharmacological activities

The pharmacological activities research of Pouteria varied widely. The pharmacological activity trends under study can be seen in the Figure 3 and in Table 3.

Antioxidant activity

Antioxidant activity was the most reported from Pouteria genus. Some extracts and fractions of Pouteria active as antioxidant. Many species of Pouteria have antioxidant activities included methanol extract of stem bark *P. cambodiana* with IC₅₀ against DPPH 0.24 mg/ml,¹⁶ acetone extract, methanol and acetone fractions of *P. campechiana* fruit,³ ethanol and water extracts of *P. campechiana* fruits with different level maturity of 4, 8, 12, 16, 20 and 24 weeks as antioxidant against DPPH,

**Table 3: Pharmacological activities of Pouteria genus.**

Species	Part Used							Pharmacological activities	Ref.
	R	RB	F	S	St	StB	L		
<i>P. torta</i>	+		+	+	+	+	+	a. Leaves: cytotoxic effect on <i>Artemia salina</i> , breast tumor cell, antimutagenic, antiplasmodial, active to α -glucosidase and α -amylase. b. Stem and root: active as antiplasmodial c. Fruits: active to α -glucosidase d. Stem bark: active to α -glucosidase and α -amilase	4; 12; 28; 51; 53; 54; 55
<i>P. ramiflora</i>	+	+	+	+	+	+	+	a. Root extract: active as antinociceptive, antiinflammation and antiplasmodial b. Leaves extract: active to α -glucosidase, α -amilase, as antioxidant, antinociceptive, antiinflammation, and antiplasmodial c. Stem and stem bark: active as antiplasmodial	4; 8; 35; 51
<i>P. gardneri</i>		+					+	a. Root bark: active as antileishmanial and trypanocidal b. Leaves: active to α -glucosidase and α -amilase	51; 55
<i>P. caimito</i>			+		+		+	a. Leaves: active as antioxidant, α -glucosidase and α -amilase, antimicroba for <i>Pseudomonas aeruginosa</i> , <i>Bacillus cereus</i> , and <i>Candida albicans</i> b. Fruits: active to acetylcholinesterase, and antimicroba for <i>C. albicans</i> , <i>S. aureus</i> , <i>B. cereus</i> , <i>E. coli</i> , <i>S. typhimurium</i> and toxicity effect to <i>Artemia salina</i>	5; 14; 45; 51; 56; 57
<i>P. lucuma</i>			+	+				a. Seed: active as antioxidant and gastroprotective b. Fruit: active as antioxidant and to α -amylase.	58; 59
<i>P. macrophylla</i>			+					Gallic acid in water extract fruit active as antioxidant	60
<i>P. venosa</i>					+	+	+	Leaves, stem and stem bark active as antioxidant, antimalaria and anticholinesterase and active as antimicrobial	11; 61
<i>P. reticulata</i>						+		Stem bark extract can inhibit to <i>Mycobacterium tuberculosis</i>	61
<i>P. cambodiana</i>						+		Water extract of stem bark active as immunomodulatory	13
<i>P. campechiana</i>			+	+	+	+	+	a. Fruits extract as antioxidant and hepatoprotective b. Stem bark as antioxidant and antithrombotic c. Seed extract active as antiinflammation, analgesic, and antiulcer d. Leaves extract as antioxidant, antimyotosis, antiinflammation, analgesic, antiulcer, antinociceptive, antihyperalgesic and toxic to <i>Aedes aegypti</i> and <i>Culex quinquefasciatus</i>	10; 27; 28; 36; 44; 63; 64; 65; 66; 67; 68; 69
<i>P. mammosa</i>					+			Toxicity effect to irritation of eye and skin	70
<i>P. sapota</i>			+					Extract methanol- acetate acid (85:15) active as antioxidant to DPPH, and lipophilic and hydrophilic extract as an antioxidant to DPPH and FRAP	43; 71; 72

R: root, RB: root bark, F: fruit, S: seed, St: stem, StB: stem bark

FRAP and ABTS with variation inhibition.⁴¹ Besides that, leaves extract of *P. ramiflora*⁸ and *P. venosa*,¹¹ *P. viridis* fruits extract³ and *P. splendens* leaves⁴² had antioxidant activity. Antioxidant activity of *P. caimito* leaves extract had the smallest IC₅₀ of 36.1 µg/ml compared to n-hexane and ethanol extracts.¹⁴ The phenolic group can contribute to antioxidant activity. Phenolic compound of methanol-acetic acid (85:15) fruit extract of *P. sapota* showed antioxidant activity.³⁵ Beside the phenolic group, the carotenoid group can also contribute to antioxidant activity. Ethanol extracts of *P. campechiana* fruits that were stored for 2, 4, 6, 8, 10 and 12 days gave increasing in total carotenoid content and followed by increasing in antioxidant activity.⁴³

Other pharmacological activities

Methanol extracts of *Pouteria cambodiana* stem bark¹⁶ and *P. campechiana* leaves⁴⁴ was reported to have immunomodulatory activity. *P. gardnerii*, *P. ramiflora* dan *P. torta* extracts did not show active against *Aedes aegypti*, *Rhodnius milesi* and *Dipetalogaster maxi*.²⁰ N-hexane-ethyl acetate (1:1) fraction of *P. venosa* active against *A. aegypti*.¹¹

P. ramiflora water extract and fraction of the ethanol extract of *P. torta* leaves¹² and methanol extract of *P. torta* leaves⁴² revealed to possess toxicity effect towards *Artemia salina*. While stem bark, lignum and root of *P. guianensis* have no toxicity effect towards *Artemia franciscana*.^{45,46} Pouterin compound from *P. torta* showed insecticidal effect against *Callosobruchus maculatus*, also has the ability to agglomerate erythrocytes in humans, rabbits and mice.⁴⁷ The other researches stated that stem extract of *P. sapota* active as antiplasmodium⁴⁸ and leaves extract of *P. venosa* as antimalarial.¹¹ Hydroethanol of stem and stem bark extracts of *P. guianensis* active as anti-termite against *Nasutitermes* sp.⁴⁹

Wood root extract of *P. torta* have cytotoxicity effect against HCT-8 (human colon carcinoma) with IC₅₀ 37.9 µg/ml, HL-60 (leukemia) with IC₅₀ 31.7 µg/ml, SF-295 (Brain) with IC₅₀ 30.2 µg/ml and MDA-MB-435 (melanoma) with IC₅₀ 21 µg/ml.⁴ Methanol leaves extract of *P. viridis* active as anti-HIV.⁵⁰ N-hexane leaves extract of *P. torta* active as antagonist estrogen at estrogen beta (ER_β) receptor.⁵¹

P. gardnerii, *P. ramiflora*, *P. torta*, and *P. caimito* have been tested for as inhibitor tyrosinase. Water leaves extract of *P. torta* and *P. caimito* active as an inhibitor of tyrosinase with IC₅₀ 30.01 µg/ml and 50.01 µg/ml and ethanol leaves extract of *P. ramiflora* and *P. torta* showed IC₅₀ 249.83 µg/ml and 104.34 µg/ml.⁵²

DISCUSSION

Pouteria is a genus that has many types. The plant part of the Pouteria species can be used as food ingredients and have pharmacological activities. The part of the plant which often used as food material is a fruit. The peel of fruit, leaves, branch, and stem bark were reported to have more potential in term of pharmacological activity.

Phytochemical compound in plants is generally produced through the pathway of shikimic and acetic acid. Phytochemical compounds are important components in plants. It can be isolated from the initial extraction step. The extraction method and solvent used will affect the resulting.⁷³ The extraction method can be influenced by the type and amount of phytochemical compounds which was isolated. In addition, factors of kinship in the taxonomy of a plant can affect the type of chemical compounds. Among the types of Pouteria have a kinship, namely one genus. Therefore, several types of Pouteria have the same chemical compounds.

Trends in pharmacological activity of Pouteria are antioxidant and antimicrobial activity. The pharmacological activity of a plant can be caused by the presence of chemical compounds. The type of chemical compound and the concentration of chemical compounds in a plant can affect the type of pharmacological activity or the strength of the pharmacological activity. Antioxidant activity can be caused by the

presence of the compounds from polyphenol group. Phenolic acids and flavonoids greatly contribute to antioxidant activity. The position of the OH group and the presence of double bonds on carbon atom no 2 and no 3 on flavonoids can affect the intensity of antioxidant activity. Antimicrobial activity can also be caused by the presence of compounds belonging to the polyphenol group and terpenoid derivatives. In Pouteria, many chemical compounds that have been isolated are phenol and polyphenol group and terpenoid derivatives.

CONCLUSIONS

Based on the literature, species of Pouteria which have presented to come from subtropical and tropical areas such as in North America, Central America, and Asia. *Pouteria campechiana* is the species most studied. Some pharmacological activities and phytochemical compounds of Pouteria genus have been widely stated. Extracts of Pouteria genus were demonstrated to have some pharmacological activities, however information concerning treatment the skin and other pharmacological activity of fraction and chemical compound of Pouteria genus was less. In addition, so far information on the mechanism of chemical compound from Pouteria genus guided by pharmacological activities has not been found.

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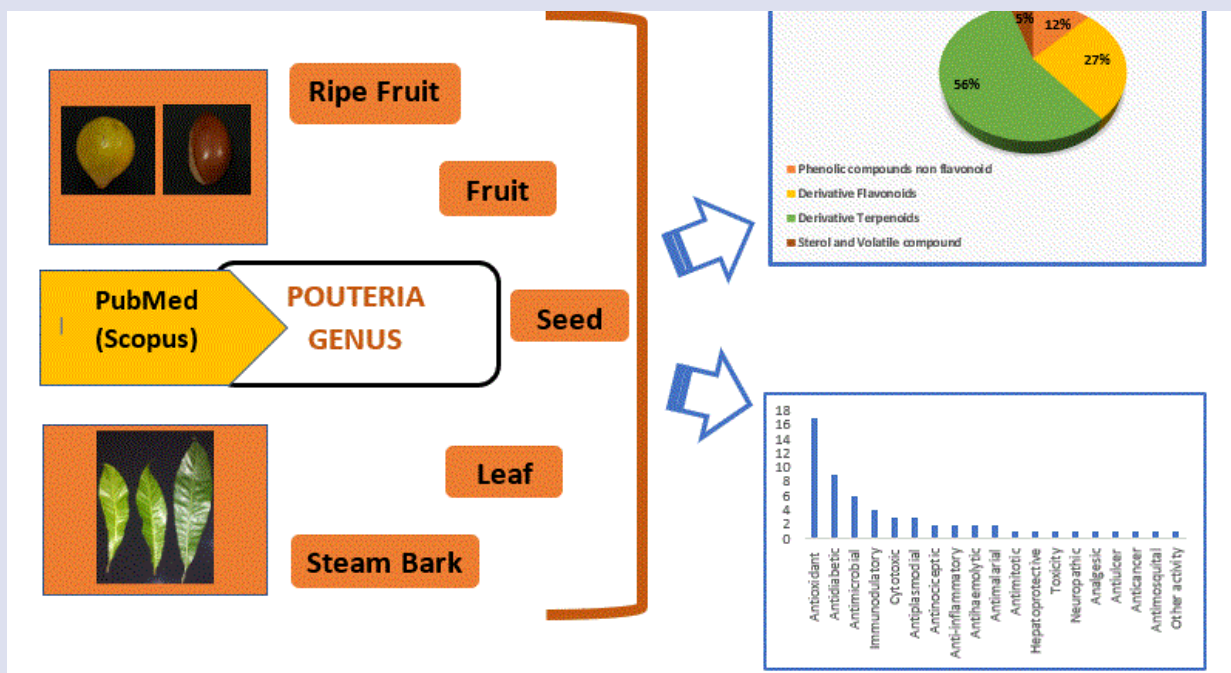
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GRAPHICAL ABSTRACT



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