A Review on Phenolic Compounds from Family Sapotaceae

Moustafa H Baky, Amal M Kamal, Mohamed R Elgindi, Eman G Haggag

Abstract

Sapotaceae is a family of flowering plants that known with wide range of chemical constituents like saponins, flavonoids and poly phenolic compounds. Phenolic compounds are widely distributed in plant kingdom and have several biological activities as anti-inflammatory, antioxidant, antibacterial, antifungal, antidiabetic and antulcer. This review focuses on the phenolic compounds identified in different species of family sapotaceae and their biological activities.

Keywords: Sapotaceae, Phenolic compounds, Flavonoids, Anti-ulcer, Anti-inflammatory, Antidiabetic

Introduction

Phytochemicals are defined as the substances found in plants that exhibit a potential for modulating human metabolism in a manner beneficial for the prevention of chronic and degenerative diseases [1]. Phenolics are defined as a class of polyphenols which are important secondary metabolites present in plants [2] and are also responsible for their antioxidant action and various beneficial effects in a multitude of diseases [3, 4]. Sticky and often white latex is found in cuts of bark, branches, leaves and fruits, although it often appears slowly in species growing in dry conditions [5].

The Sapotaceae is a family of flowering plants, belonging to order Ericales and divided into five tribes with 53 genera and about 1250 species. It consists of trees or shrubs with a worldwide distribution, although the highest species diversity is found in the tropical and subtropical regions of Asia and South America [5, 6]. Several species produce edible fruits, with or without economic uses. Species noted for their edible fruits include Manilkara (Sapodilla, sapota), Chrysophyllum cainito, Pouteria, and Planchonia careya.

Phenolic Compounds isolated from different species

Manilkara zapota: is reported to contain phenolic compounds such as: Myricetin-3-O-α-L-rhamnopyranoside, Apigenin-7-O-α-L-rhamnopyranoside and Caffeic acid, which isolated from leaves [7], Quercetin, (+)-catechin, (-)-epicatechin, (+)-gallocatechin, Gallic acid, dihydromyricetin, Methylchlorogenate, Methyl-4-O-galloyl chlorogenate, 4-O-galloylchlorogenic acid which isolated from fruits [8]. D-quercitol was reported in seeds and leaves [9]. Three phenolic compounds isolated from the fruits of Manilkara zapota; Leucodelphinidine, Leucocyanidine, Leucoperalgonidine [10].

Argania spinosa: The phenolic compounds identified in Argania spinosa seed oil (Argan oil) are Myricetin-3-O-β-D-galactopyranoside, Myricitin, Quercetin, Myrictin, Quercetrin, Hesperidin, Rutin, (+)-Catechin, (-)-Epicatechin, Caffeic acid, Ferulic acid, p-hydroxybenzoic acid, Syringic acid, Vanillic acid, Veratric acid, Gallic acid, Naringenin-7-O-glucoside and Luteolin [11].

Pouteria torta: is a species of family sapotaceae, Myricetin-3-O-α-L-arabinopyranoside, Myricetin-3-O-β-D-galactopyranoside, and Myricetin-3-O-α-L-rhamnopyranoside were isolated from leaves [12].

Pouteria campechiana: was studied for the phenolic contents of the leaves to identify; Myricetin-3-O-α-L-arabinopyranoside, Myricetin-3-O-α-L-rhamnopyranoside, Quercetin-3-O-α-L-rhamnopyranoside, Taxifolin-3-O-α-L-rhamnopyranoside, Trans-taxifolin-3-O-α-L-arabinopyranoside, Taxifolin-3-O-α-L-arabinofuranoside and Quercetin-3-O-β-
Arabinopyranoside [13].

**Pouteria sapota**: (+)-Catechin, (-)-Epicatechin, Gallic acid catechin-3-O-gallate, and myricetin and Gallocatchin-3-O-gallate were isolated from the fruits of *Pouteria sapota* [14, 15].

The presence of dihydromyricetin and (+)-Catechin-3-O-gallate in three species of *Pouteria, Sapota, viridis* and *campechiana* were reported [16].

**Pouteria obovata**: fruits contain 2R,3R-4’-O-methyl dihydrokaempferol 7-O-[3’-O-acetyl]-β-D-glucopyranoside; 2R,3R-4’-O-methyl dihydrokaempferol 7-O-β-D-β-L-xylopyranosyl(1''''→6'')-[3’-O-acetyl]-β-D-glucopyranoside and 2R,3R-4’-O-methyl dihydrokaempferol 3-O-β-D-β-L-xylopyranosyl(1''''→6'')-[3’-O-acetyl]-β-D-glucopyranoside [17].

Stem bark of *Vitellaria paradoxa* contain quercetin, (+)-Catechin and (-)-Epicatechin [18].

Other species of family Sapotaceae

Fruits and seeds of *Mimusops manilkara* studied for phenolic compounds, querctin, dihydroquerctin [19]. Myricetin-3-O-α-L-rhaminopyranoside was reported in *Chrysophyllum albidum* [20].

*Tridesmostemon omphalocarpoides* reported the presence of (-)-Epicatechin and lichexanthone in stem wood [21].

Syringic acid, Vanillic acid, Veratric acid, Gallic acid, trans-p-Coumaric acid and cis-p-Coumaric acid [22].

Gallic acid, querctin and Kampferol were identified in *Mimusops elengi* flower [23].

3’, 4’-dihydroxy-5, 2’-dimethoxy-6, 7-methylen dioxy Isoflavone was isolated from *Madhuca latifolia* fruits [24].

**Table 1: Flavonoids compounds isolated from family Sapotaceae**

<table>
<thead>
<tr>
<th>Compound</th>
<th>Structure(s)</th>
<th>Species(s)</th>
</tr>
</thead>
</table>
| Myricetin-3-O-α-L-arabinopyranoside | O-ara OH OH OH | *Pouteria torta*  
*Pouteria campechiana* |
| Myricetin-3-O-β-D-galactopyranoside | O-gal OH OH OH | *Pouteria torta*  
*Argania Spinosa* |
| Myricetin-3-O-α-L-rhaminopyranoside | O-rha OH OH OH | *Pouteria torta*  
*Manilkara zapota*  
*Chrysophyllum albidum*  
*Pouteria campechiana* |
| Myricitin | OH OH OH OH | *Argania Spinosa* |
| Quercetin | OH OH OH H | *Argania Spinosa*  
*Mimusops Manilkara*  
*Vitellaria paradoxa* |
| Myristrin | O-rha OH OH OH | *Argania Spinosa*  
*Manilkara zapota* |
| Quercetin-3-O-α-L-rhamnopyranoside | O-rha H OH OH | *Argania Spinosa*  
*Manilkara zapota*  
*Mimusops manilkara*  
*Pouteria campechiana* |
| Quercetin-3-O-β-arabinopyranoside | O-ara H OH OH | *Pouteria campechiana* |
| Rutin | O-glu-rha H OH OH | *Argania Spinosa* |
| Luteolin | H OH OH H | *Argania Spinosa* |

**Table 2: Different groups of compound isolated from family Sapotaceae**

<table>
<thead>
<tr>
<th>Compound</th>
<th>Structure(s)</th>
<th>Species(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2R,3R-4’-O-methyl dihydrokaempferol 7-O-[3’-O-acetyl]-β-D-glucopyranoside</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Pouteria obovata</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2R,3R-4'-O-methyl dihydrokaempferol 7-O-β-D-β-L-xylpyranosyl-(1''''→6'')-[3''-O-acetyl]-β-D-glucopyranoside

Pouteria obovata

2R,3R-4'-O-methyl dihydrokaempferol 3-O-β-D-β-L-xylpyranosyl-(1''''→6'')-[3''-O-acetyl]-β-D-glucopyranoside

Pouteria obovata

D-quercitol

Manilkara zapota

3',4'-dihydroxy-5,2'-dimethoxy-6,7-methylenedioxy Isoflavone

Madhuca latifolia

Naringenin-7-O-glucoside

Argania Spinosa

Lichexanthone

Tridesmostemon omphalocarpoides

Hesperidin

Argania Spinosa

Apigenin-7-O-α-L-rhamnoside

Manilkara zapota

Dihydroquercetin

Minusops

Manilkara

Dihydromyricetin

Manilkara zapota

Pouteria sapota
**Table 3:** Phenolic compounds isolated from family Sapotaceae

<table>
<thead>
<tr>
<th>Compound</th>
<th>Structure(s)</th>
<th>Species(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(+)-Catechin</td>
<td><img src="image" alt="Structure" /></td>
<td>Argania Spinosa</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Manilkara zapota</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Pouteria sapota</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Vitellaria paradoxa</em></td>
</tr>
<tr>
<td>(+)-gallocatechin</td>
<td><img src="image" alt="Structure" /></td>
<td>Manilkara zapota</td>
</tr>
<tr>
<td>(+)-Catechin-3-O-gallate</td>
<td><img src="image" alt="Structure" /></td>
<td><em>Pouteria sapota</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>P. viridis</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>P. campechiana</em></td>
</tr>
<tr>
<td>Gallocatchin-3-O-gallate</td>
<td><img src="image" alt="Structure" /></td>
<td><em>Pouteria sapota</em></td>
</tr>
<tr>
<td>Leucodelphinidine</td>
<td><img src="image" alt="Structure" /></td>
<td>Manilkara zapota</td>
</tr>
<tr>
<td>Leucocyanidine</td>
<td><img src="image" alt="Structure" /></td>
<td>Manilkara zapota</td>
</tr>
<tr>
<td>Leucoperagonidine</td>
<td><img src="image" alt="Structure" /></td>
<td></td>
</tr>
<tr>
<td>Taxifolin-3-O-α-L-rhamnopyranoside</td>
<td><img src="image" alt="Structure" /></td>
<td><em>Pouteria campechiana</em></td>
</tr>
<tr>
<td>Compound</td>
<td>Structure(s)</td>
<td>Species(s)</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>Trans-taxifolin-3-O-α-L-arabinopyranoside</td>
<td><img src="image1" alt="Structure" /></td>
<td><em>Pouteria campechiana</em></td>
</tr>
<tr>
<td>Taxifolin-3-O-α-L-arabinofuranoside</td>
<td><img src="image2" alt="Structure" /></td>
<td><em>Pouteria campechiana</em></td>
</tr>
<tr>
<td>(-)-Epicatechin</td>
<td><img src="image3" alt="Structure" /></td>
<td><em>Argania Spinosa</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Tridesmostemon omphalocarpoides</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Manilkara zapota</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Pouteria sapota</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Vitellaria paradoxa</em></td>
</tr>
</tbody>
</table>

Table 4: Phenolic acids isolated from family Sapotaceae

<table>
<thead>
<tr>
<th>Compound</th>
<th>Structure(s)</th>
<th>Species(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caffeic acid</td>
<td><img src="image4" alt="Structure" /></td>
<td><em>Argania Spinosa</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Manilkara zapota</em></td>
</tr>
<tr>
<td>Ferulic acid</td>
<td><img src="image5" alt="Structure" /></td>
<td><em>Argania Spinosa</em></td>
</tr>
<tr>
<td>trans-p-Coumaric acid</td>
<td><img src="image6" alt="Structure" /></td>
<td><em>Synsepalum dulcificum Daniell</em></td>
</tr>
<tr>
<td>cis-p-Coumaric acid</td>
<td><img src="image7" alt="Structure" /></td>
<td><em>Argania Spinosa</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Manilkara zapota</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Pouteria obovata</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Pouteria sapota</em></td>
</tr>
<tr>
<td>p-hydroxybenzoic acid</td>
<td><img src="image8" alt="Structure" /></td>
<td><em>Argania Spinosa</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Synsepalum dulcificum Daniell</em></td>
</tr>
<tr>
<td>Syringic acid</td>
<td><img src="image9" alt="Structure" /></td>
<td><em>Argania Spinosa</em></td>
</tr>
<tr>
<td>Vanillic acid</td>
<td><img src="image10" alt="Structure" /></td>
<td><em>Manilkara zapota</em></td>
</tr>
<tr>
<td>Veratric acid</td>
<td><img src="image11" alt="Structure" /></td>
<td><em>Pouteria obovata</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Pouteria sapota</em></td>
</tr>
<tr>
<td>Gallic acid</td>
<td><img src="image12" alt="Structure" /></td>
<td><em>Argania Spinosa</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Manilkara zapota</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Pouteria obovata</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Pouteria sapota</em></td>
</tr>
<tr>
<td>Methylchlorogonate</td>
<td><img src="image13" alt="Structure" /></td>
<td><em>Manilkara zapota</em></td>
</tr>
<tr>
<td>Methyl 4-O-galloychlorogonate</td>
<td><img src="image14" alt="Structure" /></td>
<td><em>Gallic acid</em></td>
</tr>
<tr>
<td>4-O-galloylchlorogenic acid</td>
<td><img src="image15" alt="Structure" /></td>
<td><em>Gallic acid</em></td>
</tr>
</tbody>
</table>
Biological activities

Anticancer and cytotoxic activity

The root bark of *Butyrospermum Parkii* showed cytotoxic activity against human breast adenocarcinoma (MDA-MB-231), malignant melanoma (A375), colon carcinoma (HCT116) and glioblastoma multiforme (T98G) cell lines [25]. *Sideroxylon foetidissimum* root extract showed greater cytotoxic activity towards the murine macrophage-like cell line RAW 264.7 cells [26].

The ethyl acetate extract of *Argania spinosa* fruits showed cytotoxic activity against human breast cancer cells (MCF7) [27].

Stem bark of *Manilkara zapota* showed potent cytotoxic activity against HL-60 and HT-29 cell lines [28].

Stem bark of *Manilkara zapota* showed antitumor activity against Ehrlich ascites carcinoma (EAC) in Swiss albino mice [29].

The MeOH extract of defatted *Vitellaria paradoxa* showed best antioxidant activity [30].

Bark extract of *Chrysophyllum pruniforme* showed cytotoxic effect [31].

Antioxidant activity

*Butyrospermum parkii* showed antioxidant activity against that of Troxol or butylated hydroxytolene (BHT) against 2, 2-diphenyl-1-picryl hydrazyl (DPPH), oxygen and nitric oxide free radicals [32].

The alcoholic extract of *Mimusops elengi* leaves showed good antioxidant activity by peroxynitrite, superoxide and hydrochloric acid scavenging activity [33].

The radical scavenging capacity of the methanolic extract of leaves in DPPH which showed antioxidant capacity [34].

The antioxidant activity of phenolic compounds isolated from *Argania spinosa* showed high antioxidant activity [35].

Seeds extract of *Manilkara zapota* showed antioxidant properties via protection against free radical-induced erythrocyte haemolysis and its ability to potentiate the antioxidant effect of Vitamin E [36].

Fruit extract of *Argania spinosa* showed potent antioxidant activity [27], *Pouteria sapota* fruit extract showed antioxidant activity [14, 38], The extract of three parts; leaves,fruits and stem of *Pouteria campechiana* reported as antioxidant [13, 22, 39].

The antioxidant activity of phenolic compounds isolated from *Manilkara zapota* fruits was studied [8].

Leaves extract of *Manilkara hexandra* showed antioxidant activity [40].

Anti-inflammatory Activity

*Mimusops elengi* leaves extract showed anti-inflammatory activity [33]. *Manilkara bidentata* ethanolic extract showed to decrease IL-1β and IL-8 pro-inflammatory cytokines so the extract could be used as anti-inflammatory and anti-aging [41].

In evaluation of anti-inflammatory activity the crude ethanolic and ethyl acetate extract of *Manilkara zapota* leaves showed significant inhibition of paw edema in albino wistar rats so exhibit significant anti-inflammatory activity [42].

Aqueous extract of *Elaeoluma nuda* was showed significant anti-inflammatory effect in rat adjuvant-induced arthritis [43].

The methanolic extract of defatted shea (*Vitellaria paradoxa*) showed anti-inflammatory activity [30].

Stem bark of *Vitellaria paradoxa* showed anti-inflammatory activity [18].  Acetone fraction of *Manilkara hexandra* seeds extract showed potent anti-inflammatory activity [44].

Anticancer and cytotoxic activity

The effect of bark alcoholic and petroleum ether extracts of *Mimusops elengi* was evaluated in rats. The alcoholic extract has significant antitumor activity compared to petroleum ether extracts of bark [45].

The alcoholic extract of bark *Mimusops elengi* and its different fractions namely ethyl acetate, N-butanol, and methanol and aqueous against different ulcer models, and concluded that Ethyl acetate fraction possesses anti-ulcer activity against experimental gastric ulcers [46].

Stem bark of *Manilkara hexandra (Roxb.)* showed anti ulcer activity against ethanol-indomethacin and pylorus ligated gastric ulcer in experimental animals [47].

The antitumor potential of aqueous extract of *Madhuca indica* was tested against naproxen induced gastric ulcer, omeprazole was used as a positive standard. Aqueous extract of plant of *M. indica* showed significant reduction in ulcerated area and ulcer index as compared to control group [48].

Antimicrobial Activity

*Achras sapota* showed antibacterial activity against Gram positive and Gram negative bacteria [49].

The methanolic extract and fractions from the stem bark of *Tridemostemon omphalocarpoides* showed significant antifungal activity against two candida species and seven aerobic bacteria [50].

Four extracts of the root of *Pachystyle brevipes* showed antibacterial and antifungal against tested microorganisms [51].

Different extracts of parts of *Mimusops elengi* were tested for antibacterial activity and showed antimicrobial activity [52-55].

The extract of stem bark of *Donella ubaguensis* showed significant antimicrobial activity against 10 tested microorganisms [56].

The methanolic extract of *Manilkara hexandra* leaves showed invivo antitumour activity against 10 tested microorganisms [56].

Antimicrobial activities of extracts of leaves, stem bark and fruits of *Butyrospermum paradoxum* [58].

Fruit extracts of *Mimusops elengi* and *Manilkara hexandra* showed antimicrobial activities [59], Manilkara hexandra leaf extract showed antimicrobial activity reported [60].

Antidiabetic activity

*Mimusops elengi* bark was reported as antidiabetic [61, 62].

The anti diabetic activity of leaves extract of *Manilkara zapota* was studied [17].

*Manilkara zapota* seeds and leaves showed marked anti diabetic activity [63, 64]. Both extract of Manilkara hexandra Leaves and Bark showed hypoglycemic effect [65, 66].

Antihyperlipidemic and hypcholesterolemic effect

Argan oil obtained from the seeds of *Argania spinosa* L. showed beneficial effect in the treatment of the hyperlipidemia and hypercholesterolemia [66]. The ethanol extract of *Mimusops elengi* L. showed significant antihyperlipidemic effect owing to its ability to reduce the levels of total cholesterol [67].
cholesterol, triglyceride and increasing the level of HDL [67]. The reported antihyperlipidemic effect of leaves of Manilkara zapota are described [7, 68].

Hepatoprotective effect

The ethanolic extract of Madhuca longifolia bark possesses hepatoprotective activity against D-galactosamine (d-GaIN) induced hepatotoxicity in rats [69]. Leaf and bark extracts of Manilkara zapota showed hepatoprotective effect [70].

Immunomodulatory activity

The methanolic stem bark extract of Pouteria cambodiana extract was showed to have immunomodulatory activity [71]. The polysaccharides from Manilkara hexandra bark significantly stimulating the immune system function. This activity may be due to the stimulation of macrophage function which is a known action of botanical polysaccharides [72]. The ethanolic extract of Madhuca longifolia showing significant immunostimulatory activity [73].

Other biological activities

Manilkara zapota leaves showed analgesic and antipyretic activities [43, 74], gastroprotective effect [75], Antifungal activity [77, 78] and aqueous extract showed Acaricidal activity [79]. Ethyl acetate extract of Argania spinosa showed antiinflammatory activity [25]. Skin-whitening and chemopreventive [30].

References