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Review Article

Chemical Constituents and Health Benefits of Four Chinese Plum Species

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Prunus is a large genus in the Rosaceae family of flowering plants, comprising over 340 species inhabiting variable landscapes in the world. Over 500 listed phytochemicals have been isolated from this single genus so far. The present study focused four Chinese *Prunus* species, viz., *Prunus cerasifera*, *Prunus domestica*, *Prunus salicina*, and *Prunus spinosa*, due to their uses, demand, nutritional value, medicinal importance, and diverse biological potential. The current review article highlights the details about the active phytochemicals and various pharmacological activities already reported. Almost 212 compounds, the majority of which are flavonoids, phenolic acids, anthocyanins, and their derivatives, which have been isolated from these four *Prunus* species fall in different categories and are helpful to evade chronic oxidative stress-mediated diseases. A huge variation exists in the total phytochemicals composition in different *Prunus* species, making these species to have different biological activities in multiple disease conditions, and even the same variety growing under different edaphic conditions may have different antioxidant capacities. It is suggested to perform extensive and indepth studies to find new phytochemicals from these four Chinese *Prunus* species which could boost the local industry to fulfill the increasing demands.

1. Introduction

Prunus is a large genus (340 species) comprising variable habit of plants belonging to family Rosaceae of flowering plants. The major representatives of the genus *Prunus* include plums, cherries, peaches, apricots, and almonds [1]. Over 500 listed phytochemicals have been isolated from this single genus so far from this genus. In the past few decades, plums have been explained as health-promoting foods due to their anti-inflammatory actions, improving neurological disorders and strong antioxidant nature mainly because of phenolic compounds and anthocyanins [2].

Prunus species are rich in biologically active ingredients, e.g., apigenin bears strong anticancer properties as a study by Jiang and colleagues showed that it inhibits hypoxia-inducible factor-1 (HIF-1) and vascular endothelial growth factor (VEGF) expression in human ovarian cancer cells [3]. Moreover, Apigenin inhibited tumorigenesis as examined by Matrigel plug assay and chorioallantoic membrane assay (CAM assay) [3]. Similarly, another active ingredient luteolin in *Prunus* species, which is also reported to show strong anticancer activity by inhibiting the growth and invasion of prostate cancer (PC3) cells, is used to check lung metastasis in an *in vivo* study, and hence, it is highlighted that luteolin targets E-cadherin and may be a useful way to cure invasive prostrate cancer [4]. Chrysin shows anticancer effects by potentially inhibiting HIF-1α [5], while kaempferol, quercetin, and multiforin extracted from *Prunus* species showed strong antioxidant potential in the DPPH radical scavenging assay [6–8]. Traditionally, plums are dried and processed for a prolonged shelf life of plums. Considering the dried fruits in terms of the phytochemical constituents, the presence of antioxidants has been reported to be the maximum compared with other dried fruits or vegetables [9].

Reactive oxygen/nitrogen species (ROS/RNS) are important physiological molecules involved, among others, in cell signaling and host defense [10]. However, an uncontrolled and excessive ROS/RNS production may overwhelm the antioxidant capacity of the cells and lead to deleterious oxidative stress, which is implicated in the pathogenesis of numerous chronic diseases [11]. Various polyphenolic compounds or plant extracts, as natural antioxidants, are regarded as a potential treatment option in prophylaxis and adjunctive therapy of CVD, and their mechanisms of action, including possible interactions with ROS/RNS, are closely looked into the restriction of onset of oxidative stress-mediated disease [12].

1.1. Aims and Objectives. As the genus *Prunus* is one of the largest ones, there is no authentic and detailed study describing the biological activities of its constituents in four Chinese *Prunus* species, viz., *P. cerasifera*, *P. domestica*, *P. salicina*, and *P. spinosa*. Hence, the current review article will highlight the details about the active phytochemicals and various pharmacological activities already reported.

2. Chemical Constituents of Four Plum Species

Almost 212 compounds, the majority of which were flavonoids and phenolic acids, isolated from different *Prunus* species have been classified under different categories and summarized in Tables 1–3.

2.1. Flavonoids. Approximately 113 flavonoids compounds (Table 1, Figure 1) including 9 anthocyanins (**1**–**9**), 33 proanthocyanins (**10**–**42**), 55 flavone and flavonols (**43–92, 105–106, 110–111, 113**), 13 dihydroflavonols (**93**–**104**), 3 isoflavonoids (**107**–**109**), and 1 dihydrochalcone (**112**) were identified from *P. cerasifera*, *P. domestica*, *P. salicina*, and *P. spinosa*.

2.2. Phenolic Acids. The analysis of phenolic acids (Table 2, Figure 2) indicated that chlorogenic acid was the predominant compound. Seven benzoic acid derivatives (**114–120, 140**, **141**), 7 cinnamic acid derivatives (**121**–**127, 148, 149**), 6 caffeoylquinic acid derivatives (**128**–**133**), 2 feruloylquinic acid derivatives (**134**, **135**), 3 comaroylquinic acid derivatives (**136**–**139**), 2 shikimic acid (**142**, **143**), ellagic acid (**145**), 2 propionic acid (**146**, **147**), 2 abscisic acid (**152**, **153**), and 3 abscisic acid derivatives (**154**–**158**) were identified from *P. cerasifera*, *P. domestica*, *P. salicina*, and *P. spinosa*.

2.3. Others. A total of 16 individual phenolic compounds have been identified from *P. domestica*. The major components identified and quantitated by HPLC-ESI-MS comprise (**163**, **166**, **167**, **180**), along with a neolignane (**171**), two guajacyl-glycerin-coniferyl aldehyde isomers (**172**, **173**) and dehydro-diconiferyl aldehyde (**174**). Three cyanogenic glycosids (**167**-**169**) were identified from *P. spinosa.* Four organic acids (**175**-**178**) and vitamin C (**179**) contents of three plum species (*P. cerasifera*, *P. domestica*, and *P. spinosa*.) were determined by the HPLC method. Two carbaldehyde derivatives (**180**, **181**), 3 steroids (**185**–**187**), 4 terpenoids (**188-191, 204, 205**), 8coumarin derivatives (**193-201**), 3 cinnamic acid derivatives (**202**, **203**, **209**), and 2 glucosyl terpenates (**205**, **208**) were identified from different *Prunus* species (Table 3, Figure 3).

3. Biological Activities of Four Plum Species

Various compounds have been isolated from different *Prunus* species and classified under different categories, viz., polyphenols, flavonoids, anthocyanins, alkaloids, and terpenes. The pharmacological properties of all four Chinese plum species have been discussed in the next sections.

3.1. Prunus cerasifera. Cherry plum (*P. cerasifera* Ehrh. and Rosaceae) or "Myrobalan plum" is a well-known medicinal plant and is a rich source of polyphenolics, anthocyanins, carotenoids, flavonoids, various organic acids, aromatic compounds, tannins, minerals, vitamins, and antioxidant compounds [13, 71]. The Myrobalan plum fruits are rich in health-promoting phytochemicals that help prevent the onset of different diseases. The *P. cerasifera* fruit has strong antibacterial and antifungal potential of pathogenic class for medical sciences and agricultural product-related pathogens [72]. The purple Myrobalan plum fruit peels have high amounts of anthocyanins and phenolic compounds due to which it showed high antioxidant activity [24]. Considerable differences have also been reported for *P. cerasifera* accessions with regard to total phenolics and antioxidant activity [73]. Another report highlighted that tannins found in *P. cerasifera* have high antioxidant properties and showed potential inhibition of tyrosinase activity and, thus, could be used as a strong inhibitor for the onset of melanogenesis [29]. Gunduza and Saracoglu studied various fruit characteristics (total phenolics and antioxidant activity) in different accessions of *P. cerasifera* from Turkey and reported considerable variation for these characters among the accessions, but the phenolic contents are comparable to many other plum species [73]. The antioxidant capability of plums mainly depends on the level of ripening, and this trend is entirely opposite to that of the phenolic contents [74]. The leaves of *P. cerasifera* are enriched with biologically active ingredients, notably tannins, flavonoids, and phenolic acids,

Table 1: Flavonoids compounds isolated and identified from different *Prunus*.

No.	Compounds	Sources	Ref.
1	Cyanidin-3-galactoside	*P. cerasifera Ehrh.*, *P. salicina Lindl.*	[13–17]
2	Cyanidin-3-glucoside	*P. cerasifera Ehrh.*, *P. salicina Lindl.*, *P. domestica L.*, *P. spinosa L.*	[13–15, 18–27]
3	Cyanidin-3-rutinoside	*P. cerasifera Ehrh.*, *P. salicina Lindl.*, *P. domestica L.*, *P. spinosa L.*	[13–27]
4	Cyanidin-3-acetylglucoside	*P. cerasifera Ehrh.*	[13]
5	Cyanidin-3-xyloside	*P. cerasifera Ehrh.*, *P. domestica L.*	[13, 23, 27]
6	Cyanidin-3-pentoside	*P. spinosa L.*	[21, 28]
7	Peonidin-3-rutinoside	*P. spinosa L.*, *P. domestica L.*	[18, 21–25, 27]
8	Peonidin-3-glucoside	*P. spinosa L.*, *P. domestica L.*	[19–25, 27]
9	Peonidin-3-acetylglucoside	*P. spinosa L.*	[21]
10	Afzelechin	*P. cerasifera Ehrh.*, *P. spinosa L.*	[29, 30]
11	Epiafzelechin	*P. cerasifera Ehrh.*, *P. spinosa L.*	[29–31]
12	(+)-Catechin	*P. salicina Lindl.*, *P. domestica L.*, *P. cerasifera Ehrh.*, *P. spinosa L.*	[8, 15, 16, 24, 29–39]
13	(−)-Epicatechin	*P. salicina Lindl.*, *P. domestica L.*, *P. spinosa L.*	[15, 16, 24, 29–32, 35, 36, 38–42]
14	Epigallocatechin	*P. spinosa L.*	[30]
15	Gallocatechin	*P. spinosa L.*	[30]
16	Procyanidin B1	*P. salicina Lindl.*, *P. domestica L.*	[15, 16, 35, 36, 39]
17	Procyanidin B2	*P. salicina Lindl.*, *P. domestica L.*	[15, 16, 28, 35, 36, 39]
18	Epicatechin 3-*O*-gallate	*P. domestica L.*	[39]
19	*Ent*-epicatechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-catechin	*P. spinosa L.*	[30, 31, 43]
20	*Ent*-epicatechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-catechin 5,7,11,12,5′11′,12′-heptamethyl ether-3,3′-diacetate	*P. spinosa L.*	[31, 43]
21	*Ent*-epicatechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-catechin-nona-acetate	*P. spinosa L.*	[43]
22	*Ent*-epigallocatechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epicatechin	*P. spinosa L.*	[30]
23	*Ent*-epicatechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epiafzelechin	*P. spinosa L.*	[30, 43, 44]
24	*Ent*-epicatechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epiafzelechin 7,12,5′,12′-tetramethyl ether	*P. spinosa L.*	[44]
25	*Ent*-epicatechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epicatechin	*P. spinosa L.*, *P. spinosa L.*	[32, 36, 43]
26	*Ent*-epicatechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epicatechin 5,7,11,12,5′11′,12′-heptamethyl ether-3,3′-diacetate	*P. spinosa L.*	[43]
27	*Ent*-epicatechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epicatechin 7,11,12,5′11′,12′-hexamethyl ether-3,5,3′-triacetate	*P. spinosa L.*	[43]
28	*Ent*-epicatechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epicatechin-nona-acetate	*P. spinosa L.*	[43]
29	*Ent*-epiafzelechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epicatechin	*P. spinosa L.*	[30, 32, 43–45]
30	*Ent*-epiafzelechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epiafzelechin 7,12,5′,12′-tetramethyl ether-3,5,3′-triacetate	*P. spinosa L.*	[44]
31	*Ent*-epiafzelechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epiafzelechin-hepta-acetate	*P. spinosa L.*	[43, 44]
32	*Ent*-epiafzelechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epicatechin 7,12,5′,11′,12′-pentamethyl ether	*P. spinosa L.*	[44]
33	*Ent*-epiafzelechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epicatechin-octa-acetate	*P. spinosa L.*	[44]
34	*Ent*-epiafzelechin -(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epicatechin 5,7,12,5′11′,12′-hexamethyl ether-3,3′-diacetate	*P. spinosa L.*	[43]
35	*Ent*-epiafzelechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epicatechin 7,12,5′11′,12′-pentamethyl ether-3,5,3′-triacetate	*P. spinosa L.*	[43]
36	*Ent*-epiafzelechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epicatechin-3′-*O*-gallate	*P. spinosa L.*	[30]
37	*Ent*-epicatechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-epicatechin-3′-*O*-gallate	*P. spinosa L.*	[30]
38	*Ent*-epiafzelechin-(2$\alpha\longrightarrow O\longrightarrow$7; 4$\alpha\longrightarrow$8)-catechin	*P. spinosa L.*	[30, 45]

Table 1: Continued.

No.	Compounds	Sources	Ref.
39	*Ent*-epiafzelechin-(2α⟶*O*⟶7; 4α⟶8)-catechin-octa-acetate	*P. spinosa L.*	[43]
40	Proanthocyanidin oligomer	*P. domestica L.*	[46]
41	Epicatechin-4,8′-epicatechin-4′,8″-epicatechin	*P. domestica L.*	[36]
42	Epicatechin-4,8′-epicatechin-(2′α⟶*O*⟶7′′; 4′α⟶8″)-epicatechin	*P. domestica L.*	[36]
43	Quercetin	*P. spinosa L.*, *P. domestica L.*, *P. cerasifera Ehrh.*	[28, 30–32, 36, 38, 47–50]
44	Quercetin-3-*O*-α-L-arabinofuranoside	*P. spinosa L.*, *P. spinosa L.*	[32, 33, 47]
45	Quercetin-3-rutinoside	*P. salicina Lindl.*, *P. domestica L.*, *P. cerasifera Ehrh.*, *P. spinosa L.*	[8, 15, 16, 21, 22, 24, 26, 28, 30, 35–39, 42, 49–55]
46	Quercetin-3-*O*-glucoside	*P. salicina Lindl.*, *P. domestica L.*, *P. spinosa L.*	[15–17, 19, 21, 22, 24, 26, 28, 35, 36]
47	Quercetin-3-*O*-xyloside	*P. salicina Lindl.*, *P. cerasifera Ehrh.*	[15–17, 56]
48	Quercetin-3-*O*-arabinoside	*P. salicina Lindl.*, *P. domestica L.*, *P. cerasifera Ehrh.*	[15, 16, 24, 56]
49	Quercetin-3-*O*-rhamnoside	*P. salicina Lindl.*, *P. domestica L.*, *P. cerasifera Ehrh.*	[15, 16, 28, 32, 35, 36, 56]
50	Quercetinl-7-*O*-α-L-rhamnopyransoide	*P. domestica L.*	[32]
51	Quercetin-3-*O*-β-D-galactoside	*P. salicina Lindl.*, *P. domestica L.*, *P. domestica L.*, *P. cerasifera Ehrh.*	[17, 19, 24, 26, 28, 32, 35, 36, 56]
52	Quercetin-3-*O*-α-D-xylopyranoside	*P. domestica L.*	[32]
53	Quercetin-3-*O*-α-D-glucopyranoside	*P. domestica L.*	[32]
54	Quercetin-pentoside	*P. domestica L.*	[28, 36, 39]
55	Quercetin-pentoside-rhamnoside	*P. domestica L.*	[36]
56	Quercetin pentosyl-hexoside	*P. salicina Lindl.*, *P. domestica L.*	[15, 16, 39]
57	Quercetin pentosyl-pentoside	*P. salicina Lindl.*	[15, 16, 39]
58	Quercetin-acetylhexoside	*P. salicina Lindl.*, *P. domestica L.*	[15, 16, 39]
59	Quercetin-deoxyhexose	*P. domestica L.*	[39]
60	Quercetin-3-*O*-(4″-*O*-β-D-glucopyranosyl)-α-L-rhamnopyransoide	*P. domestica L.*	[32]
61	Quercetin-3-*O*-(6″-*O*-α-L-rhamnopyranosyl)-β-D-glucopyranoside(rutin)	*P. spinosa L.*	[32]
62	Quercetin-3-*O*-(2″-*O*-β-D-glucopyranosyl)-α-L-arabinofuranoside	*P. spinosa L.*	[32, 33, 47]
63	Hyperin	*P. cerasifera Ehrh.*	[50]
64	Kaempferol	*P. spinosa L.*, *P. domestica L.*, *P. spinosa L.*, *P. cerasifera Ehrh.*	[30–33, 47–50, 57, 58]
65	Apigenin	*P. cerasifera Ehrh.*	[50]
66	Kaempferol-3-*O*-α-D-glucoside	*P. cerasifera Ehrh.*	[50, 56]
67	Kaempferol-3,7-di-*O*-α-L-rhamnopyranoside	*P. spinosa L.*	[30–32, 47]
68	Kaempferol-7-*O*-α-L-rhamnopyransoide	*P. spinosa L.*	[32, 33, 47]
69	Kaempferol-3-*O*-α-L-arabinofuranoside-7-*O*-α-L-rhamnopyransoide	*P. spinosa L.*	[32, 33, 47]
70	Kaempferol-3-*O*-α-L-arabinofuranoside	*P. spinosa L.*, *P. cerasifera Ehrh.*	[30, 32, 33, 47, 56]
71	Kaempferol-3-*O*-arabinoside-7-*O*-rhamnoside	*P. spinosa L.*	[30, 32]
72	Kaempferol-3-*O*-α-D-xylopyranoside-7-*O*-α-L-rhamnopyransoide(lepidoside)	*P. spinosa L.*	[32, 33]
73	Kaempferol-3-*O*-α-D-xylopyranoside	*P. spinosa L.*, *P. cerasifera Ehrh.*	[32, 56]
74	Kaempferol-3-*O*-α-L-rhamnopyransoide	*P. spinosa L.*, *P. cerasifera Ehrh.*	[32, 33, 56]
75	Kaempferol-3-*O*-(2″-E-p-conmaroyl)-α-L-arabinofuranoside	*P. spinosa L.*	[32]
76	Kaempferol-3-*O*-rutinoside	*P. spinosa L.*	[21, 28]
77	Kaempferol-3-*O*-α-L-arabinopyranoside-7-*O*-α-L-rhamnopyransoide	*P. spinosa L.*	[33]
78	5,4′-Dihydroxyflavone-7-*O*-α-D-glucoside	*P. domestica L.*	[59]
79	Kaempferol-hexoside	*P. domestica L.*	[28, 39]
80	Kaempferol-pentoside-rhamnoside	*P. domestica L.*	[28]

Table 1: Continued.

No.	Compounds	Sources	Ref.
81	Kaempferol-pentoside	*P. domestica L.*	[28]
82	Kaempferol-3-*O*-(4″-*O*-β-D-glucopyranosyl)-α-L-rhamnopyransoide	*P. spinosa L.*	[32]
83	Kaempferol-3-*O*-(2″-E-*p*-conmaroyl)-α-L-arabinofuranoside-7-*O*-α-L-rhamnopyransoide	*P. spinosa L.*	[32, 33, 47]
84	Myricetin	*P. salicina Lindl.*, *P. domestica L.*	[20, 35, 40, 48, 49]
85	Luteolin	*P. spinosa L.*, *P. cerasifera Ehrh.*	[41, 50]
86	Luteolin-4′-*O*-α-D-glucoside	*P. cerasifera Ehrh.*	[50]
87	Prudomestin	*P. domestica L.*	[60]
88	3,5,7-Trihydroxy-4′-methoxyflavanone	*P. domestica L.*	[57]
89	Isorhamnetin-3-*O*-rutinoside	*P. domestica L.*	[24, 28, 35]
90	Isorhamnetin-3-*O*-glucoside	*P. domestica L.*	[24, 26]
91	Isorhamnetin-3-*O*-galactoside	*P. domestica L.*	[26]
92	Quercetin-4′-*O*-α-D-glucoside	*P. cerasifera Ehrh.*	[50]
93	Hesperetin	*P. salicina Lindl.*	[40]
94	Isosakuranetin	*P. domestica L.*	[60]
95	Dihydrokaempferide	*P. domestica L.*	[60]
96	Naringenin	*P. domestica L.*	[60]
97	3,5,7-Trihydroxy-8,4′-dimethoxyflavanone	*P. domestica L.*	[58, 60]
98	3,5,7-Trihydroxy-6,4′-dimethoxyflavanone	*P. domestica L.*	[59, 60]
99	5,7,4′-Trihydroxy-3-methoxyflavanone.	*P. domestica L.*	[60]
100	7,4′-Dimethylaromadendrin	*P. domestica L.*	[57]
101	5,7-Dihydroxy-4′-methoxy-dihydroflavonol	*P. domestica L.*	[57]
102	5,7-Dihydroxy-8,4′-dimeth-oxyllavonol	*P. domestica L.*	[57]
103	Dihydrokaempferol-3-*O*-α-L-rhamnoside	*P. cerasifera Ehrh.*	[56]
104	Dihydrokaempferol-3-*O*-α-D-glucoside	*P. cerasifera Ehrh.*	[56]
105	Prudomestiside A	*P. domestica L.*	[59]
106	Prudomestiside B	*P. domestica L.*	[59]
107	Purunuside A	*P. domestica L.*	[61]
108	Purunuside B	*P. domestica L.*	[61]
109	Purunuside C	*P. domestica L.*	[61]
110	Prunusins A	*P. domestica L.*	[58]
111	Prunusins B	*P. domestica L.*	[58]
112	Phloridzin	*P. spinosa L.*, *P. domestica L.*, *P. cerasifera Ehrh.*	[37]
113	5,2′-Dihydroxy-7,5′-dimethoxyflavanone	*P. domestica L.*	[59]

Table 2: Phenolic acids compounds isolated and identified from different *Prunus* species.

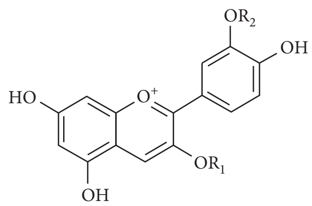
No.	Compounds	Sources	Ref.
114	Vanillic acid	*P. spinosa L.*, *P. domestica L.*, *P. cerasifera Ehrh.*	[37, 41, 49, 52, 53, 62, 63]
115	Protocatechuic acid	*P. spinosa L.*, *P. domestica L.*, *P. spinosa L.*	[6, 30, 39, 41, 42, 48, 52–54, 62]
116	*p*-Hydroxybenzoic acid	*P. spinosa L.*, *P. domestica L.*	[41, 49, 53]
117	Vanillic acid-β-glucoside	*P. domestica L.*	[6, 36]
118	Vanillic acid-α-D-glucopyranoside	*P. domestica L.*	[52]
119	Gallic acid	*P. spinosa L.*, *P. domestica L.*, *P. cerasifera Ehrh.*, *P. spinosa L.*	[19, 30, 37, 49, 50, 53, 54, 62]
120	Syringic acid	*P. spinosa L.*, *P. domestica L.*, *P. cerasifera Ehrh.*	[34, 37, 38, 41, 49, 53]
121	Caffeic acid	*P. spinosa L.*, *P. domestica L.*, *P. cerasifera Ehrh.*, *P. spinosa L.*	[6, 8, 19, 20, 30, 32, 34, 37, 42, 48, 49, 51, 52, 54]
122	Caffeic acid methyl ester	*P. domestica L.*	[52, 63]

Table 2: Continued.

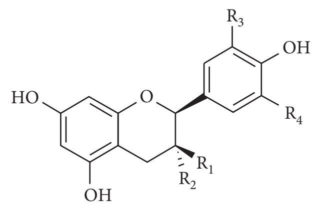
No.	Compounds	Sources	Ref.
123	Ferulic acid	*P. spinosa L.*, *P. domestica L.*, *P. cerasifera Ehrh.*	[37, 48, 49, 62]
124	*p*-Coumaric acid	*P. spinosa L.*, *P. domestica L.*, *P. cerasifera Ehrh.*	[6, 8, 24, 32, 34, 37, 39, 41, 42, 49, 51, 52]
125	Cinnamic acid	*P. domestica L.*	[49]
126	Ferulic acid-*β*-D-glucopyranoside	*P. domestica L.*	[52, 63]
127	Coniferine	*P. domestica L.*	[52, 63]
128	3-*O*-Caffeoylquinic acid (neochlorogenic acid)	*P. salicina Lindl.*, *P. domestica L.*, *P. spinosa L.*	[8, 15–17, 21, 22, 24–26, 28, 32, 33, 35, 36, 42, 48, 51, 53, 54]
129	4-*O*-Caffeoylquinic acid	*P. spinosa L.*, *P. domestica L.*	[21, 22, 24, 28, 32, 33, 35, 36, 42, 51–53]
130	5-*O*-Caffeoylquinic acid	*P. salicina Lindl.*, *P. domestica L.*, *P. cerasifera Ehrh.*, *P. spinosa L.*	[15, 16, 22, 25, 26, 28, 32, 34–38, 42, 48, 49, 51–54, 62, 64]
131	3-*O*-Caffeoylquinic acid methyl ester	*P. domestica L.*	[36, 52, 63]
132	4-*O*-Caffeoylquinic acid methyl ester	*P. domestica L.*	[36, 52, 63]
133	5-*O*-Caffeoylquinic acid methyl ester	*P. domestica L.*	[36]
134	3-*O*-Feruloylquinic acid	*P. spinosa L.*, *P. domestica L.*	[21, 32, 33, 35, 36]
135	4-*O*-Feruloylquinic acid	*P. spinosa L.*	[32]
136	3-*O*-Coumaroylquinic acid	*P. spinosa L.*, *P. domestica L.*	[8, 15, 16, 21, 25, 28, 32, 33, 36, 53]
137	4-*O*-Comaroylquinic acid	*P. spinosa L.*	[32]
138	5-*O*-Comaroylquinic acid	*P. spinosa L.*.	[32]
139	3-Coumaroylquinic acid methyl ester	*P. domestica L.*	[36]
140	Salicylic acid	*P. domestica L.*	[49]
141	2,3-Dimethylbenzoic acid	*P. domestica L.*	[38]
142	Shikimic acid	*P. domestica L.*	[39]
143	3-Caffeoylshikimic acid	*P. domestica L.*	[35, 36]
144	2-(3′,4′-Dihydroxyphenyl)acetic acid	*P. spinosa L.*	[65]
145	Ellagic acid	*P. domestica L.*	[49]
146	3-(4′-Hydroxyphenyl)propionic acid	*P. spinosa L.*	[65]
147	3-(3′,4′-Dihydroxyphenyl)propionic acid	*P. spinosa L.*	[65]
148	Caffeoyl hexoside	*P. domestica L.*	[39]
149	*p*-Coumaroyl-hexoside	*P. domestica L.*	[39]
150	3,4-Dihydroxybenzoyl-glucoses	*P. domestica L.*	[36]
151	Rosmarinic acid	*P. domestica L.*	[49]
152	Abscisic acid	*P. domestica L.*	[52, 66]
153	*β*-D-glusosylabscisate	*P. domestica L.*	[52, 66]
154	Rel-5-(1*R*,5*S*-dimethyl-3*R*,4*R*,8*S*-trihydroxy-7-oxabicyclo (3,2,1)-oct-8-yl)-3-methyl-2*Z*,4*E*-pentadienoic acid	*P. domestica L.*	[52, 66]
155	Rel-5-(1*R*,5*S*-dimethyl-3*R*,4*R*,8*S*-trihydroxy-7-oxa-6-oxobicyclo (3,2,1) oct-8-yl)-3-methyl-2*Z*,4*E*-pentadienoic acid	*P. domestica L.*	[52, 66]
156	Rel-5-(3*S*,8*S*-dihydroxy-1*R*,5*S*-dimethyl-7-oxa-6-oxobicyclo (3,2,1) oct-8-yl)-3-methyl-2*Z*,4*E*-pentadienoic acid	*P. domestica L.*	[52, 66]
157	Rel-5-(3*S*,8*S*-dihydroxy-1R,5*S*-dimethyl-7-oxa-6-oxobicyclo s oct-8-yl)-3-methyl-2*Z*,4*E*-pentadienoic acid-3′-*O*-*α*-D-glucopyranoside	*P. domestica L.*	[52, 66]
158	(6*S*,9*R*)-roseoside	*P. domestica L.*	[52, 66]

Table 3: Others compounds isolated and identified from different *Prunus*.

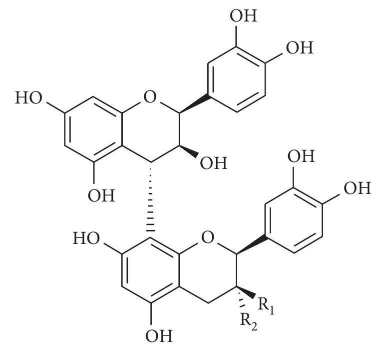
No.	Compounds	Sources	Ref.
159	*p*-Hydroxybenzaldehyde	*P. domestica L.*	[53]
160	Benzoic acid	*P. spinosa L., P. domestica L.*	[36, 38, 49, 53, 62]
161	Syringaldehyde	*P. domestica L.*	[53]
162	Hydroxy-4-methoxybenzaldehyde	*P. domestica L.*	[38]
163	Vanillin	*P. spinosa L., P. domestica L.*	[49, 53, 62]
164	Protocatechuic aldehyde	*P. spinosa L.*	[62]
165	Coniferyl aldehyde	*P. domestica L.*	[53]
166	Dimethoxycinnamaldehyde	*P. domestica L.*	[53]
167	Amygdalin	*P. cerasifera Ehrh. P. domestica L.*	[53, 67]
168	Prunasin	*P. cerasifera Ehrh.*	[67]
169	Sambunigrin	*P. cerasifera Ehrh.*	[67]
170	Coniferyl aldehyde	*P. domestica L.*	[52]
171	Pinoresinol-*O*-*α*-D-glucopyranoside	*P. domestica L.*	[52]
172	Guajacyl-glycerin-coniferyl aldehyde-1	*P. domestica L.*	[53]
173	Guajacyl-glycerin-coniferyl aldehyde-2	*P. domestica L.*	[53]
174	Dehydro-diconiferyl aldehyde	*P. domestica L.*	[53]
175	Fumaric acid	*P. spinosa L., P. domestica L., P. cerasifera Ehrh.*	[37]
176	Malic acid	*P. spinosa L., P. domestica L., P. cerasifera Ehrh.*	[37]
177	Succinic acid	*P. spinosa L., P. domestica L., P. cerasifera Ehrh.*	[37]
178	Citric acid	*P. spinosa L., P. domestica L., P. cerasifera Ehrh.*	[37]
179	Vitamin C	*P. spinosa L., P. domestica L., P. cerasifera Ehrh.*	[37]
180	2-(5-Hydroxymethyl-2′,5′-dioxo-2′,3′,4′,5′-tetrahydro-1′H-1,3′-bipyrrole)-carbaldehyde	*P. domestica L.*	[52]
181	Hydroxymethylfurfural	*P. domestica L.*	[52]
182	Benzyl-*β*-primeveroside	*P. domestica L.*	[52, 63]
183	Vanillin diglucoside	*P. domestica L.*	[53]
184	4-Amino-4-carboxychroman-2-one	*P. domestica L.*	[6]
185	*β*-Sitosterol	*P. domestica L., P. cerasifera Ehrh.*	[50, 61]
186	Daucosterol	*P. cerasifera Ehrh.*	[50]
187	Stigmasterol	*P. cerasifera Ehrh.*	[50]
188	Ursolic acid	*P. cerasifera Ehrh.*	[50]
189	Arjunolic acid	*P. cerasifera Ehrh.*	[50]
190	Niga-ichigoside F1	*P. cerasifera Ehrh.*	[50]
191	Lupeol	*P. cerasifera Ehrh.*	[50]
192	3-(*α*-D-glucopyranosyloxymethyl)-2-(4-hydroxy-3-methoxyphenyl)-5-(3-hydroxypropyl)-7-methoxy-(2*R*,3*S*)-dihydrobenzofuran	*P. domestica L.*	[52, 66]
193	5-Hydroxy-6-methoxy-7-*O*-*β*-D-glucosyl coumarin	*P. spinosa L.*	[30, 31]
194	5-Hydroxy-6-methoxy-7-*O*-*α*-D-rhamnosyl coumarin	*P. spinosa L.*	[30]
195	5,7-Dimethoxy-6-hydroxy-coumarin	*P. domestica L.*	[57, 68]
196	7-Methocycoumarin	*P. domestica L.*	[42]
197	Esculin	*P. domestica L.*	[36]
198	Scopolin	*P. domestica L.*	[69]
199	Scopoletin	*P. domestica L.*	[52, 63, 70]
200	Magnolioside	*P. domestica L.*	[52, 63]
201	6,7-Methylenedioxy-8-methoxycoumarin	*P. domestica L.*	[61]
202	(3-*O*-*cis*-p-Coumaroyl-*α*-D-fructofuranosyl)-(2⟶1)-*α*-D-glucopyranoside	*P. domestica L.*	[69]
203	(3-*O*-*trans*-p-Coumaroyl-*α*-D-fructofuranosyl)-(2⟶1)-*α*-D-glucopyranoside	*P. domestica L.*	[69]
204	2,7-Dimethyl-2*E*,4*E*-octadienedioic acid	*P. domestica L.*	[69]
205	*α*-D-Glucopyranosyl 7-carboxy2-methyl-2*E*,4*E*-octadienate	*P. domestica L.*	[69]
206	1*S*-(4-*α*-D-glucopyranosyl-3-methoxyphenyl)-2*R*-[4-(3-hydroxypropyl)-2-methoxyphenoxy]-1,3-propanediol	*P. domestica L.*	[69]
207	*α*-D-glucopyranosyl 9-carboxy-8-hydroxy-2,7-dimethyl-2*E*,4*E*-nonadienate	*P. domestica L.*	[69]
208	8-Hydroxy-2,7-dimethyl-2*E*,4*E*-decadienedioic acid 1-*α*-D-glucopyranyl ester 10-Methyl ester	*P. domestica L.*	[69]
209	*α*-D-glucopyranosyl cinnamate	*P. domestica L.*	[69]
210	(-)-Dihydrodehydrodiconiferyl alcohol	*P. domestica L.*	[70]
211	(-)-Ficusal	*P. domestica L.*	[70]
212	(*E*)-3, 3′-dimethoxy -4,4′-dihydroxystilbene	*P. domestica L.*	[70]



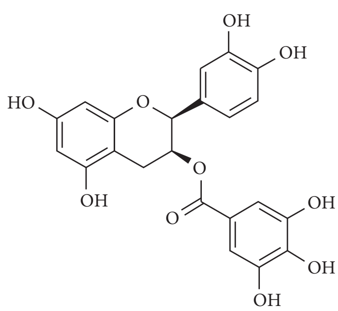
1 R_1 = Gal; R_2 = H
2 R_1 = glucosyl; R_2 = H
3 R_1 = α-L-rhamnosyl-β-D-glucose; R_2 = H
4 R_1 = acetylglucosyl; R_2 = H
5 R_1 = Xyl; R_2 = H
6 R_1 = pentosyl; R_2 = H
7 R_1 = α-L-rhamnosyl-β-D-glucose; R_2 = CH_3
8 R_1 = glucosyl; R_2 = CH_3
9 R_1 = acetylglucosyl; R_2 = CH_3



10 R_1 = H; R_2 = OH; R_3 = H; R_4 = H
11 R_1 = OH; R_2 = H; R_3 = H; R_4 = H
12 R_1 = H; R_2 = OH; R_3 = OH; R_4 = H
13 R_1 = OH; R_2 = H; R_3 = OH; R_4 = H
14 R_1 = OH; R_2 = H; R_3 = OH; R_4 = OH
15 R_1 = H; R_2 = OH; R_3 = OH; R_4 = OH



16 R_1 = OH; R_2 = H
17 R_1 = H; R_2 = OH



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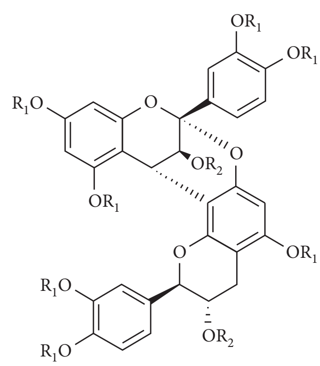
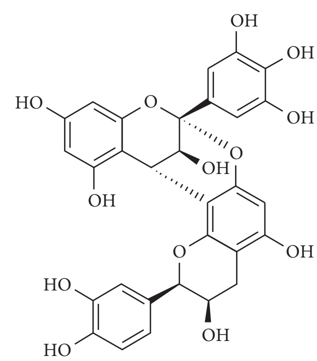
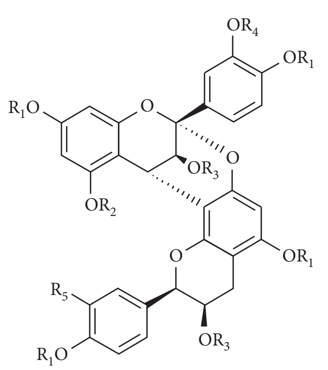


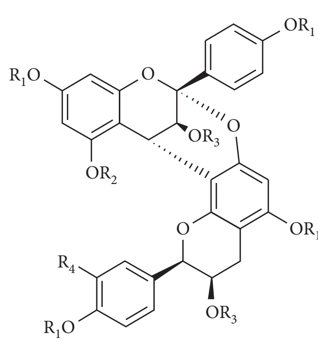
19 R_1 = H; R_2 = H
20 R_1 = CH_3; R_2 = Ac
21 R_1 = Ac; R_2 = Ac



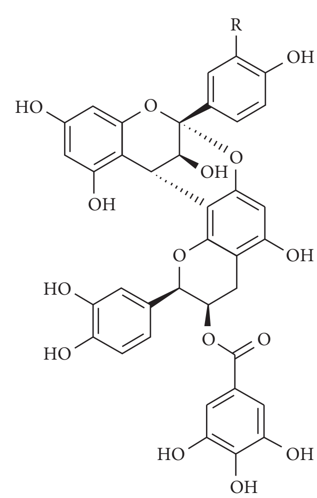
22



23 R_1 = H; R_2 = H; R_3 = H; R_4 = H; R_5 = H
24 R_1 = CH_3; R_2 = H; R_3 = H; R_4 = H; R_5 = H
25 R_1 = H; R_2 = H; R_3 = H; R_4 = H; R_5 = OH
26 R_1 = CH_3; R_2 = CH_3; R_3 = Ac; R_4 = CH_3; R_5 = OCH_3
27 R_1 = CH_3; R_2 = Ac; R_3 = Ac; R_4 = CH_3; R_5 = OCH_3
28 R_1 = Ac; R_2 = Ac; R_3 = Ac; R_4 = Ac; R_5 = OAc



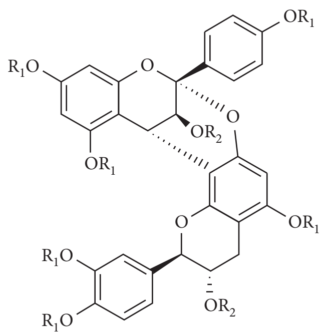
29 R_1 = H; R_2 = H; R_3 = H; R_4 = OH
30 R_1 = CH_3; R_2 = Ac; R_3 = Ac; R_4 = H
31 R_1 = Ac; R_2 = Ac; R_3 = Ac; R_4 = H
32 R_1 = CH_3; R_2 = Ac; R_3 = Ac; R_4 = OCH_3
33 R_1 = Ac; R_2 = Ac; R_3 = Ac; R_4 = OAc
34 R_1 = CH_3; R_2 = CH_3; R_3 = Ac; R_4 = OCH_3
35 R_1 = CH_3; R_2 = Ac; R_3 = Ac; R_4 = OCH_3



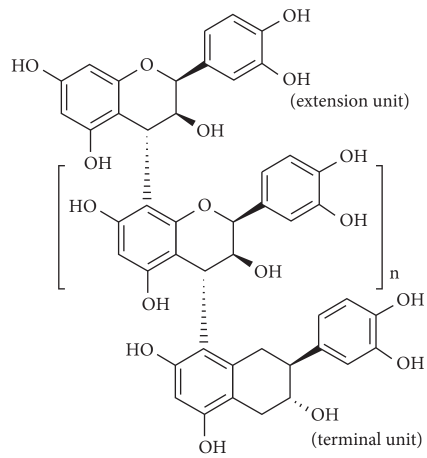
36 R = H
37 R = OH

(a)

Figure 1: Continued.



38 R_1 = H; R_2 = H
39 R_1 = Ac; R_2 = Ac



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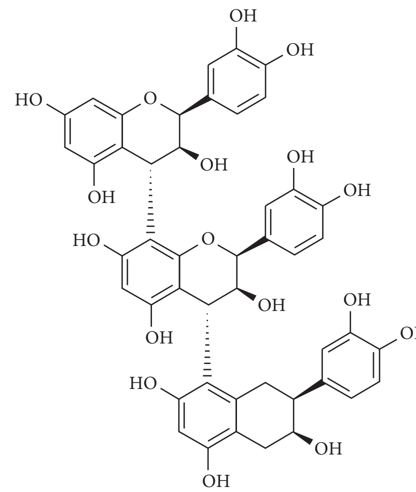
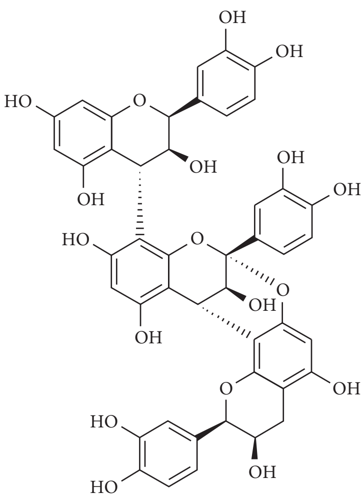
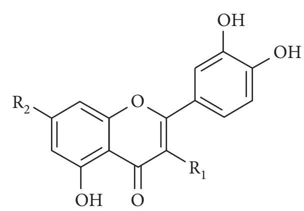


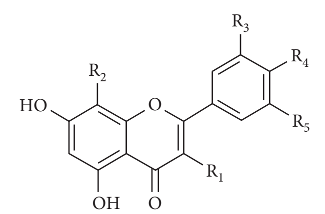
41



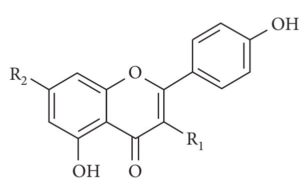
42



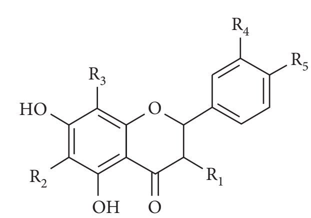
43 R_1 = OH; R_2 = OH
44 R_1 = *O*-L-arabinofuranose; R_2 = OH
45 R_1 = *α*-L-rhamnosyl-*β*-D-glucose; R_2 = OH
46 R_1 = *α*-D-Glu; R_2 = OH
47 R_1 = Xyl; R_2 = OH
48 R_1 = arabinoside; R_2 = OH
49 R_1 = *α*-L-rhamnopyranosyl; R_2 = OH
50 R_1 = OH; R_2 = *α*-L-rhamnopyranosyl
51 R_1 = *O*-*β*-D-Gal; R_2 = OH
52 R_1 = *O*-*α*-D-Xyl; R_2 = OH
53 R_1 = *β*-D-Glu; R_2 = OH
54 R_1 = pentosyl; R_2 = OH
55 R_1 = pentosyl-*α*-L-rhamnopyranosyl; R_2 = OH
56 R_1 = pentosylhexoside; R_2 = OH
57 R_1 = pentosyl-pentosyl; R_2 = OH
58 R_1 = acetylhexoside; R_2 = OH
59 R_1 = deoxylhexoside; R_2 = OH
60 R_1 = 4″-*β*-D-glucopyrnosyl-*α*-L-rhamnopyrnosyl; R_2 = OH
61 R_1 = 6″-*α*-L-rhamnopyrnosyl-*β*-D-glucopyrnosyl; R_2 = OH
62 R_1 = 2″-*β*-D-glucopyrnosyl-*α*-L-arabinofuranose; R_2 = OH
63 R_1 = *β*-D-galactopyranosyloxy; R_2 = OH



84 R_1 = OH; R_2 = H; R_3 = OH; R_4 = OH; R_5 = OH
85 R_1 = H; R_2 = H; R_3 = OH; R_4 = OH; R_5 = H
86 R_1 = H; R_2 = H; R_3 = OH; R_4 = b-D-Glu; R_5 = H
87 R_1 = OH; R_2 = OCH_3; R_3 = H; R_4 = OCH_3; R_5 = H
88 R_1 = OH; R_2 = H; R_3 = H; R_4 = OCH_3; R_5 = H
89 R_1 = *O*-*α*-L-Rha-*β*-D-Glu; R_2 = H; R_3 = OCH_3; R_4 = OH; R_5 = H
90 R_1 = *O*-Glu; R_2 = H; R_3 = OCH_3; R_4 = OH; R_5 = H
91 R_1 = *O*-Gal; R_2 = H; R_3 = OCH_3; R_4 = OH; R_5 = H
92 R_1 = OH; R_2 = H; R_3 = OH; R_4 = *β*-D-Glu; R_5 = H



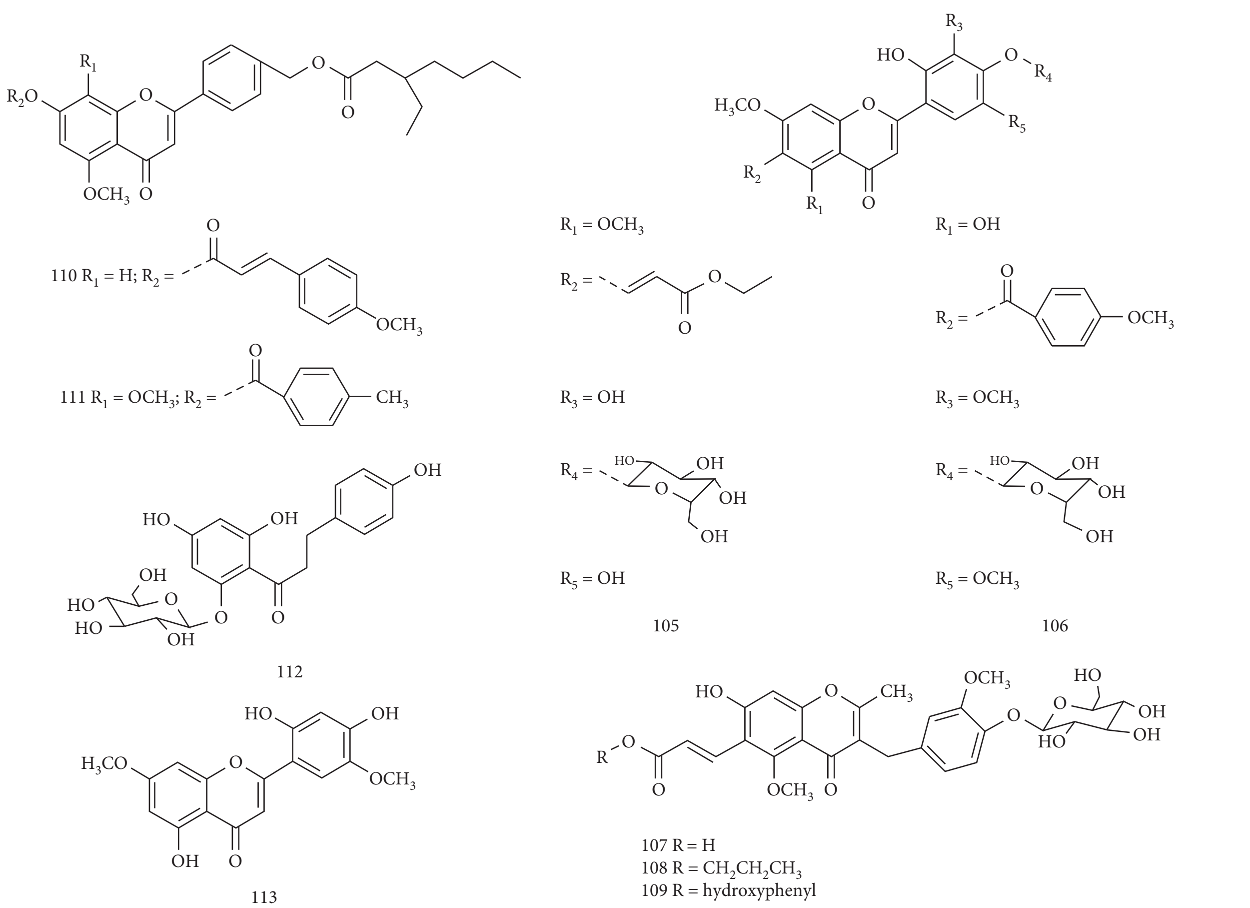
64 R_1 = OH; R_2 = OH
65 R_1 = H; R_2 = OH
66 R_1 = *β*-D-Glu; R_2 = OH
67 R_1 = *α*-L-rhamnopyranosyl; R_2 = rhamnopyranosyl
68 R_1 = OH; R_2 = *α*-L-rhamnopyranosyl
69 R_1 = *α*-L-arabinofuranose; R_2 = *α*-L-rhamnopyranosyl
70 R_1 = *α*-L-arabinofuranose; R_2 = OH
71 R_1 = arabinofuranose; R_2 = rhamnopyranosyl
72 R_1 = O-*β*-D-xylopyranose; R_2 = *α*-L-rhamnopyranosyl
73 R_1 = O-*β*-D-xylopyranose; R_2 = OH
74 R_1 = *α*-L-rhamnopyranosyl; R_2 = OH
75 R_1 = 2″-E-p-conmaroyl-*α*-L-arabinofuranose; R_2 = OH
76 R_1 = *α*-L-rhamnosyl-*β*-D-glucose; R_2 = OH
77 R_1 = *α*-L-arabinofuranose; R_2 = *α*-L-rhamnopyranosyl
78 R_1 = H; R_2 = *β*-D-Glu
79 R_1 = hexosyl; R_2 = OH
80 R_1 = pentosyl-rhamnopyranosyl; R_2 = OH
81 R_1 = pentosyl; R_2 = OH
82 R_1 = 4″-*β*-D-glucopyrnosyl-*α*-L-rhamnopyrnosyl; R_2 = OH
83 R_1 = 2″-E-p-conmaroyl-*α*-L-arabinofuranose; R_2 = *α*-L-rhamnopyrnosyl



93 R_1 = H; R_2 = H; R_3 = H; R_4 = OH; R_5 = OCH_3
94 R_1 = H; R_2 = H; R_3 = H; R_4 = H; R_5 = OCH_3
95 R_1 = OH; R_2 = H; R_3 = H; R_4 = H; R_5 = OCH_3
96 R_1 = H; R_2 = H; R_3 = H; R_4 = H; R_5 = OH
97 R_1 = OH; R_2 = H; R_3 = OCH_3; R_4 = H; R_5 = OCH_3
98 R_1 = OH; R_2 = OCH_3; R_3 = H; R_4 = H; R_5 = OCH_3
99 R_1 = OCH_3; R_2 = H; R_3 = H; R_4 = H; R_5 = OH
100 R_1 = OCH_3; R_2 = H; R_3 = H; R_4 = H; R_5 = OCH_3
101 R_1 = H; R_2 = H; R_3 = H; R_4 = H; R_5 = OCH_3
102 R_1 = H; R_2 = H; R_3 = OCH_3; R_4 = H; R_5 = OCH_3
103 R_1 = O-a-L-Rha; R_2 = H; R_3 = H; R_4 = H; R_5 = OH
104 R_1 = O-*β*-D-Glu; R_2 = H; R_3 = H; R_4 = H; R_5 = OH

(b)

Figure 1: Continued.



(c)

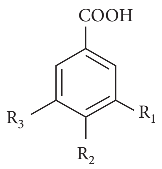
FIGURE 1: Chemical structures of flavonoids from *Prunus* species.

all of which show high antioxidant activity [50, 75]. Excessive presence of various natural and edible pigments in leaves and branches of *P. cerasifera* make it more demanding in the world market, especially the anthocyanins rich in red edible pigments for beverage industry [29, 76–78].

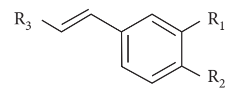
3.2. Prunus domestica. The Cherry plum (*Prunus domestica* L., Rosaceae) is famous as "Mirabelle plum" or "Myrobalan," and its fruits display a huge variation in size, shape, taste, and appearance [24]. Fresh fruits of *P. domestica* are processed into dried functional food so that they keep its potential health effects shown by the presence of plenty of phenolics and antioxidants [54]. *Prunus* kernels which actually are the dried form of the fruits are achieved at 85–90°C for 18 hours [79] and have been utilized in medicine for centuries [63]. In different parts of the world, especially in Southeast Asia, prunes are being administered alone or in combination with other medicines to cure menstrual disorders, leucorrhoea, and debility after the miscarriage [80]. Moreover, plums have a laxative effect due to high fibre contents and higher phenolic contents [81, 82]. Certain studies reported that high phenolics may pose positive health effects on the development and strengthening of bones and memory-related issues, reduce inflammations, release constipation, and scavenge ROS [83–87]. The higher antioxidant activity of extracts of *P. domestica* is mainly because of the presence of phenolic compounds, especially the isomers of caffeoylquinic acid [6, 63].

The oral administration of the *Prunus* fruit extracts (75, 100, 150 mg/kg) to male mice gave much higher learning and memory enhancement [88]. The chlorogenic acid isolated from *P. domestica* reduces the anxiolytic-like effect *in vitro* which is linked with anxiety behaviour and provides protection to granulocytes by avoiding ROS efflux [64]. The improvement of bone structure and its biomechanical properties is linked with the usage of higher doses of plums that downregulates the expression of TNF-α in lymphocytes [89], as well as retention of bone calcium ions [86].

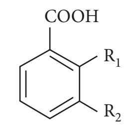
The fruit flesh extract of *P. domestica* inhibited the cell proliferation of breast cancer cells (MCF-7, MDA-MB-453, and MCF-10A cell lines), as well as reduces the toxicity levels in the normal cells [84]. Furthermore, prunes are also found to reduce various other cancers such as colon cancer by inducing apoptosis without any harm to the normal neighbouring cells [90–92]. For human liver cancer cells



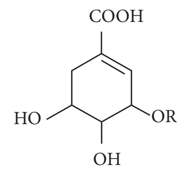
114 $R_1 = OCH_3$; $R_2 = OH$; $R_3 = H$
115 $R_1 = OH$; $R_2 = OH$; $R_3 = H$
116 $R_1 = H$; $R_2 = OH$; $R_3 = H$
117 $R_1 = OCH_3$; $R_2 =$ *O*-*β*-D-glc; $R_3 = H$
118 R_1 = OCH3; R_2 = *O*-*β*-D-glucosyl; R3 = H
119 $R_1 = OH$; $R_2 = OH$; $R_3 = OH$
120 $R_1 = OCH_3$; $R_2 = OH$; $R_3 = OCH_3$



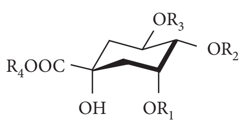
121 $R_1 = OH$; $R_2 = OH$; $R_3 = COOH$
122 $R_1 = OH$; $R_2 = OH$; $R_3 = COOCH_3$
123 $R_1 = OCH_3$; $R_2 = OH$; $R_3 = COOH$
124 $R_1 = H$; $R_2 = OH$; $R_3 = COOH$
125 $R_1 = H$; $R_2 = H$; $R_3 = COOH$
126 $R_1 = OCH_3$; $R_2 =$ *O*-*β*-D-glucosyl; $R_3 = COOH$
127 R_1 = OCH3; R_2 = *O*-*β*-D-glucosyl; $R_3 = CH_2OH$



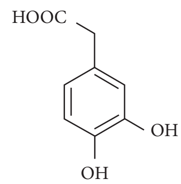
140 $R_1 = OH$; $R_2 = H$
141 $R_1 = CH_3$; $R_2 = CH_3$



142 R = H
143 R = caffeoyl



128 R_1 = caffeoyl; $R_2 = H$; $R_3 = H$; $R_4 = H$
129 $R_1 = H$; R_2 = caffeoyl; $R_3 = H$; $R_4 = H$
130 $R_1 = H$; $R_2 = H$; R_3 = caffeoyl; $R_4 = H$
131 R_1 = caffeoyl; $R_2 = H$; $R_3 = H$; $R_4 = CH_3$
132 $R_1 = H$; R_2 = caffeoyl; $R_3 = H$; $R_4 = CH_3$
133 $R_1 = H$; $R_2 = H$; R_3 = caffeoyl; $R_4 = CH_3$
134 R_1 = feruloyl; $R_2 = H$; $R_3 = H$; $R_4 = H$
135 $R_1 = H$; R_2 = feruloyl; $R_3 = H$; $R_4 = H$
136 R_1 = comaroyl; $R_2 = H$; $R_3 = H$; $R_4 = H$
137 $R_1 = H$; R_2 = comaroyl; $R_3 = H$; $R_4 = H$
138 $R_1 = H$; $R_2 = H$; R_3 = comaroyl; $R_4 = H$
139 R_1 = comaroyl; $R_2 = H$; $R_3 = H$; $R_4 = CH_3$



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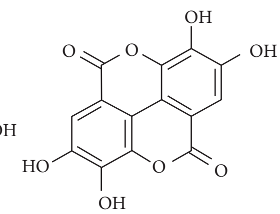
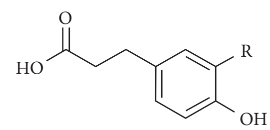
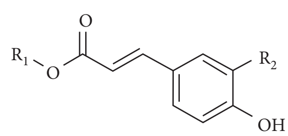


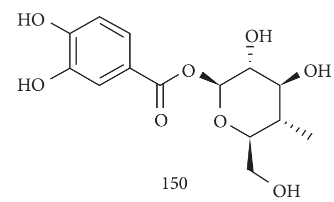
145



146 R = H
147 R = OH



148 R_1 = hexoside; $R_2 = OH$
149 R_1 = hexoside; $R_2 = H$



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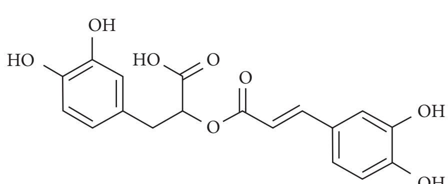

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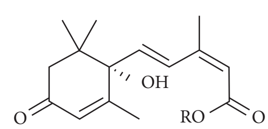
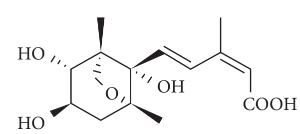


152 R = H
153 R = *β*-D-glucosyl



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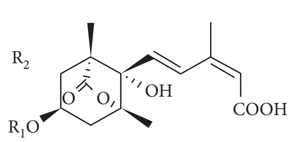
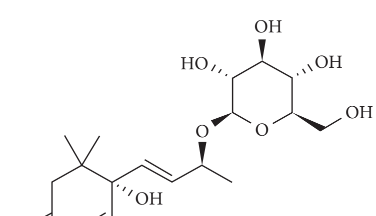


155 $R_1 = H$; $R_2 = OH$
156 $R_1 = H$; $R_2 = H$
157 $R_1 = \beta$-D-glucosyl; $R_2 = H$

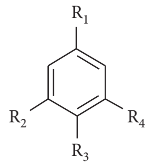


158

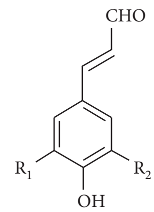
Figure 2: Chemical structures of phenolic acids from *Prunus* species.

(HepG2), prunes aid in atntiproliferation activity [90]. Moreover, the polyphenolics in prunes help in reduction in inflammatory markers such as Cyclooxygenase 2 (COX-2) [92]. The fruit extract of dried plums have been reported to be rich in polyphenolic compounds and showed a huge reduction in the inflammatory markers such as nitric oxide and melondialdehyde production in a dose-dependent manner [93]. On the other hand, another class of phytocompounds reported in *P. domestica* is polysaccharides, which reduces and completely inhibited gastric lesions in a rat model [94].

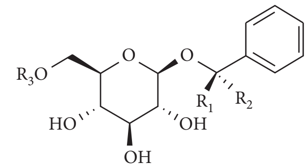
The fruit extracts of *P. domestica* showed positive results against peptic ulcer in Wistar albino rats, and it was said that due to the presence of higher amounts of polyphenolics in the fruit juices of plumes, it showed strong antioxidant potential which reduces the oxidative stress and engages various acids to neutralize the corrosive effects of various acids and, hence, appeared as antiulcerogenic [95]. Phenolic



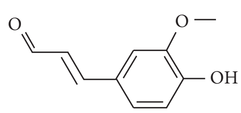
159 R_1 = CHO; R_2 = H; R_3 = OH; R_4 = H
160 R_1 = COOH; R_2 = H; R_3 = H; R_4 = H
161 R_1 = CHO; R_2 = OCH_3; R_3 = OH; R_4 = OCH_3
162 R_1 = OCH_3; R_2 = OH; R_3 = CHO; R_4 = H
163 R_1 = CHO; R_2 = OCH_3; R_3 = OH; R_4 = H
164 R_1 = CHO; R_2 = OH; R_3 = OH; R_4 = H



165 R_1 = H; R_2 = OCH_3
166 R_1 = OCH_3; R_2 = OCH_3



167 R_1 = CN; R_2 = H; R_3 = β-D-glucosyl
168 R_1 = CN; R_2 = H; R_3 = H
169 R_1 = H; R_2 = CN; R_3 = H



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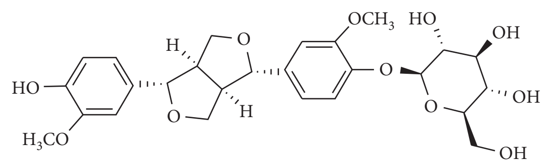

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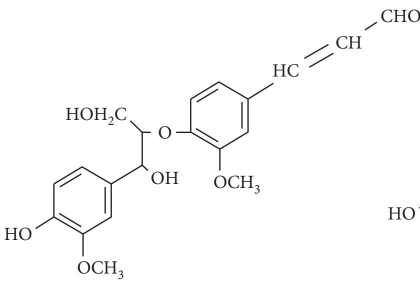

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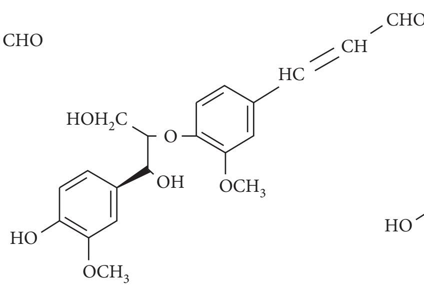

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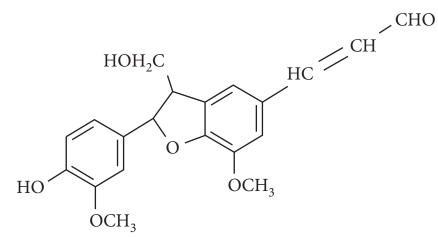

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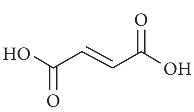

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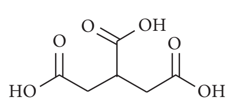

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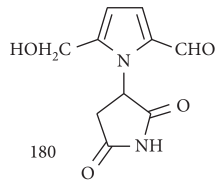

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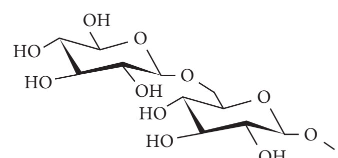
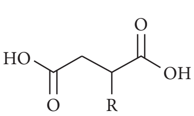
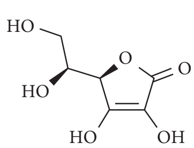


182 R = benzyl
183 R = vanillyl



176 R = OH
177 R = H



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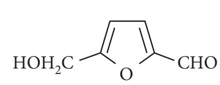

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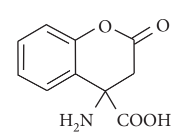
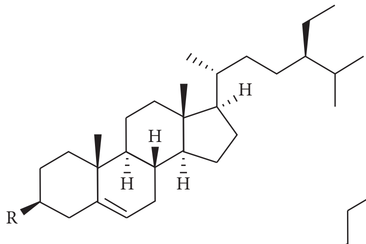
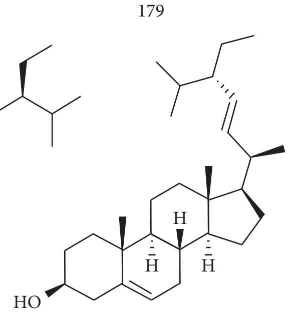


184



185 R = OH
186 R = β-D-glucosyl



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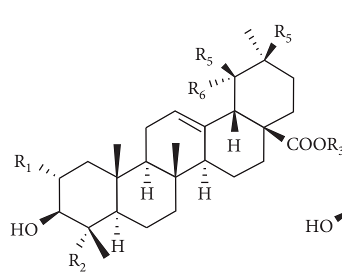
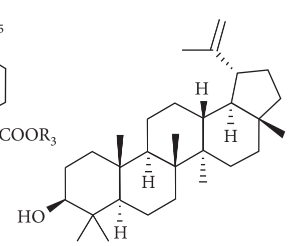


188 R_1 = H; R_2 = CH_3; R_3 = H; R_4 = H; R_5 = CH_3; R_6 = H
189 R_1 = OH; R_2 = CH_2OH; R_3 = H; R_4 = CH_3; R_5 = H; R_6 = H
190 R_1 = OH; R_2 = CH_2OH; R_3 = β-D-Glu; R_4 = H; R_5 = CH_3; R_6 = OH



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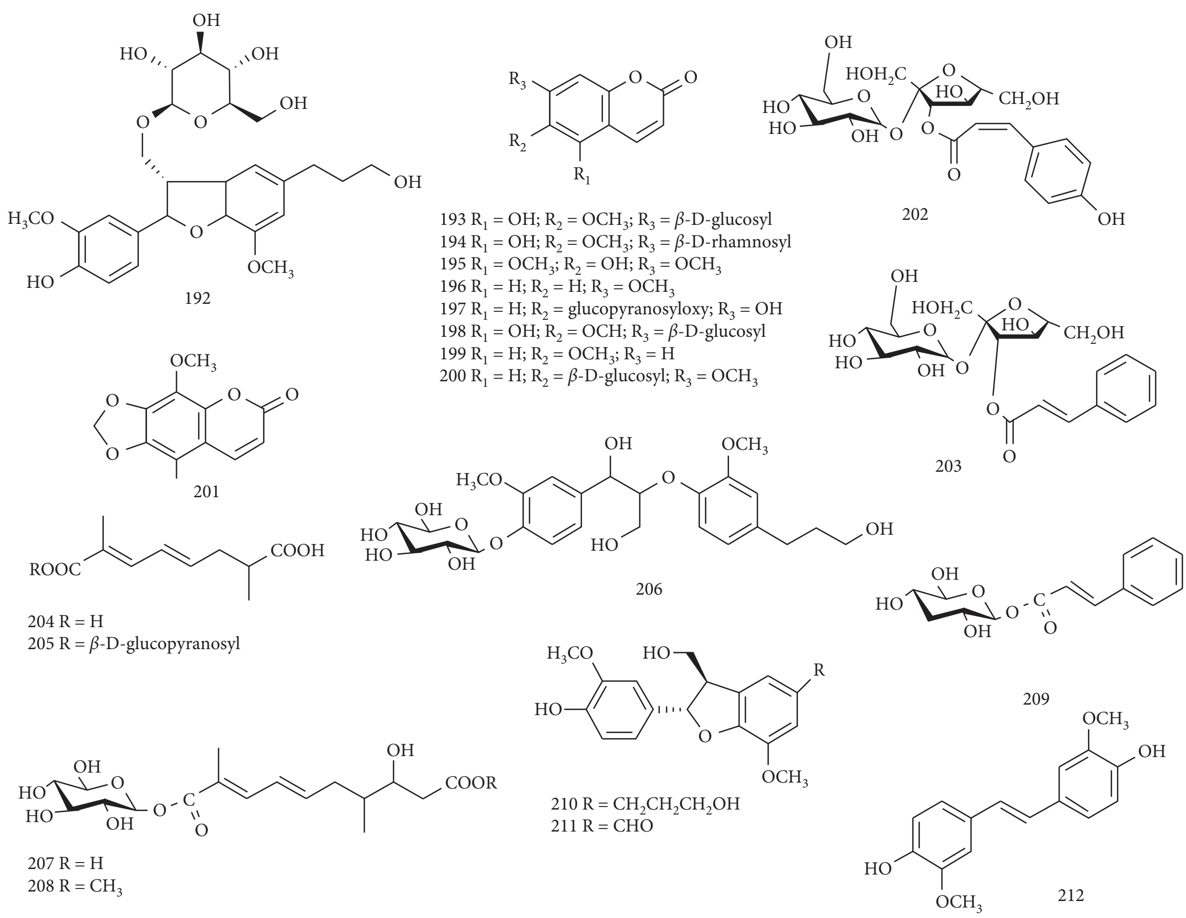
(a)

Figure 3: Continued.



(b)

Figure 3: Chemical structures of other compounds from *Prunus* species.

compounds reported in *P. domestica* minimized the H_2O_2-induced oxidative stress through reducing the intracellular ROS accumulation in granulocytes [96]. Prunes are stated as highly useful to protect against cardiovascular disorders to regulate or modulate blood pressure, prevent atherosclerosis, and boost high-density lipoproteins (HDL) [97]. *P. domestica* fruit juice (juice concentrate + prune puree + water + 7% fructose) has laxative effects on bowel functions in individuals suffering gastrointestinal issues and increases flatulence [98]. In another study, *P. domestica* fruit extracts were studied for their antiallergic responses, and it was reported that it reduces the type-I allergic symptoms in mice by adjusting type-1 helper T-cell/type-2 helper T-cell balance and suppression of mast cell degranulation [99].

3.3. Prunus salicina Lindl. The oriental plum (*Prunus salicina* Lindley, *Rosaceae*), locally called as Chinese plum, is reported to be a rich source of various pigments such as anthocyanins and polyphenolic compounds. Foods enriched with polyphenolic compounds using oriental plum can improve the symptoms of neurodegenerative diseases by reducing the brain cholesterol levels and upregulation of neurodegenerative-related proteins [100]. The crude extracts of the peels and flesh of *P. salicina* fruit prepared in acetone have strong anticancer properties as reported for inducing apoptosis in MDA-MB-231 cells [53, 101]. Moreover, *P. salicina* fruits are rich in phenolic antioxidants (82%), of which a nitrogenous compound amygdalin is in higher quantity, which is banned by the FDA as a cancer chemotherapeutic agent [53].

The *P. salicina* fruits extracts were prepared at various levels of fruit maturity, i.e., immature, partial-mature, and fully mature fruits, and these extracts showed strong anticancer potential against various cancer cell lines, viz. HepG2, Kato11, Hela, U937 lukaemia cells, MCF-7 cells, and MDA-MB-231 human breast cancer cell lines [101]. The mechanism for this anticancer activity was due to the cytotoxic effects of the *P. salicina* fruit extracts containing polyphenolics that activate apoptotic pathway leading to the programmed cell death [101]. In another study, *P. salicina* fruit juices showed antiadipogenic effects and reduce inflammations, blood glucose levels, triglycerides, and high-density lipoproteins (HDL) cholesterol levels in obese rats [102]. The fruit extracts of *P. salicina* are rich bioactive compounds when mixed with the food supplements which help reduce mite allergic responses [99].

3.4. Prunus spinosa L. Blackthorn or sloe (*Prunus spinosa* L., Rosaceae) is widely cultivated throughout the world [103]. *P. spinosa* is resistant to cold, drought, and calcareous soils and represents one of the ancestors of *P. domestica* [104]. Like all other Chinese prunes, *P. spinosa* also bears strong biological constituents. Active components of the plant are believed to be polyphenols, including flavonoids and A-type proanthocyanidins, anthocyanins, coumarins, and phenolic acids, forming unique and diversified profiles in particular organs, among which the flowers are the least characterized [30, 33, 43, 47, 105–108]. The unique composition of phytochemicals in the *P. spinosa* plant may correspond to the distinctive activity profile reported by traditional Chinese medication systems. Other than traditional Chinese medicine, huge literature reports ethnomedicinal and ethnopharmacological uses of *P. spinosa*, which showed its potential benefits to cure various diseases [1, 32]. *P. spinosa* fruits and its juice could be considered as a valuable source of antioxidant compounds for nutritional supplementation, as well as of herbal medicine [18]. *P. spinosa* L. flowers are a traditional herbal medicine recommended for the adjunctive treatment of oxidative stress-related diseases [65].

4. Conclusions and Further Prospective

The major phytochemicals have been isolated from four Chinese plum species including polyphenols, flavonoids, and anthocyanins. There occur huge variations in the total phytochemicals contents in different species, which make these different species to have different biological activities in multiple disease conditions, and even the same variety growing under different edaphic conditions may have different antioxidant capacities. Moreover, 212 known compounds have been reported to be present in these four Chinese plum species, which are helpful to evade chronic oxidative stress-mediated diseases. Moreover, it is suggested to perform some extensive and in-depth studies to find new phytochemicals from these four Chinese plum species which could boost the local industry to fulfill the increasing demands.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Acknowledgments

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