



Review

# Apiaceae Medicinal Plants in China: A Review of Traditional Uses, Phytochemistry, Bolting and Flowering (BF), and BF Control Methods

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**Abstract:** Apiaceae plants have been widely used in traditional Chinese medicine (TCM) for the removing dampness, relieving superficials, and dispelling cold, etc. In order to exploit potential applications as well as improve the yield and quality of Apiaceae medicinal plants (AMPs), the traditional use, modern pharmacological use, phytochemistry, effect of bolting and flowering (BF), and approaches for controlling BF were summarized. Currently, about 228 AMPs have been recorded as TCMs, with 6 medicinal parts, 79 traditional uses, 62 modern pharmacological uses, and 5 main kinds of metabolites. Three different degrees (i.e., significantly affected, affected to some extent, and not significantly affected) could be classed based on the yield and quality. Although the BF of some plants (e.g., *Angelica sinensis*) could be effectively controlled by standard cultivation techniques, the mechanism of BF has not yet been systemically revealed. This review will provide useful references for the reasonable exploration and high-quality production of AMPs.



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**Keywords:** Apiaceae medicinal plants; traditional use; phytochemistry; bolting and flowering; controlling approaches

## 1. Introduction

Apiaceae (syn. Umbelliferae) is one of the largest angiosperm families. It includes 300 genera (3000 species) globally and 100 genera (614 species) in China [1]. Apiaceae plants have been widely used in healthcare, nutrition, the food industry, and other fields [2]. Currently, 55 genera (230 species) of Apiaceae plants have been used as medicinal plants, and over 20 species have been widely used as traditional Chinese medicines (TCMs) [3]. Extensive studies have demonstrated that Apiaceae medicinal plants (AMPs) present a variety of pharmacological properties for the treatment of central nervous system, cardiovascular, and respiratory system diseases, amongst others [1,4]. These pharmacological activities are largely associated with metabolites such as polysaccharides, alkaloids, phenylpropanoids (simple phenylpropanoids and coumarins), flavonoids, and polyene alkynes [1,5,6].

In China, Apiaceae plants have been primarily used as traditional medicines for relaxing tendons, activating blood, relieving superficial wounds, treating colds, etc. [1,2]. For example, rhizomatous and whole plants are mainly used for the treatment of common colds, coughs, asthma, rheumatic arthralgia, ulcers, and pyogenes infections; fruits are mainly used for regulating vital energy, promoting digestion, relieving abdominal pain, and treating parasites [1,2].

The occurrence of bolting and flowering (BF) plays a critical role in the transition from vegetative growth to reproductive development in the plant life cycle [7]. However, BF

significantly reduces the accumulation of metabolites in vegetative organs, which ultimately leads to the lignification of rhizomes and/or roots such as sugar beet [8], lettuce [9], and Chinese cabbage [10]. In particular, it is common that BF significantly reduces the yield and quality of the rhizomatous AMPs [11]. Extensive studies have demonstrated that BF is regulated by both internal factors (e.g., germplasm resource, seedling size, and plant age) and external factors (e.g., vernalization, photoperiodism, and environmental stresses) [12]. To date, the BF of most rhizomatous AMPs have not been effectively controlled [11,13].

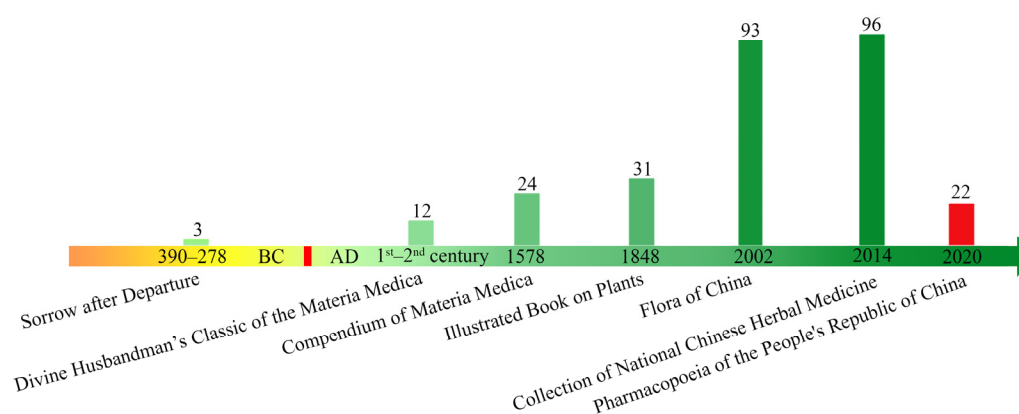
In order to form a comprehensive understanding of the current status of AMPs in China, herein, the progress on traditional use, phytochemistry, BF, and controlling approaches are summarized. This review will provide useful references for the efficient cultivation and quality improvement of AMPs.

## 2. Materials and Methods

Information on AMPs was attained using scientific databases (i.e., PubMed, Web of Science, Springer, and CNKI), using the following keywords: Apiaceae plant, traditional use, phytochemistry, BF, and lignification. Additional information was collected from ethnobotanical studies that mainly focused on the “*Flora of China*” and local classical literature, such as “*Divine Husbandman’s Classic of the Materia Medica (Shen Nong Ben Cao Jing)*”, “*Compendium of Materia Medica*”, “*Illustrated Book on Plants*”, “*Collection of National Chinese Herbal Medicine*”, and “*Pharmacopoeia of the People’s Republic of China*” (2020). The names of all plants correspond to the database *Catalogue of Life China*. Chemical structures were drawn using ChemDraw 21.0.0 software.

## 3. Apiaceae Medicinal Plants (AMPs)

Apiaceae plants have been traditionally used as medicines in China for ca. 2400 years (Figure 1). In 390–278 BC, three Apiaceae plants, including *Angelica dahurica*, *Ligusticum chuanxiong*, and *Cnidium monnieri*, were first recorded as medicines in “*Sorrow after Departure*” [1,2]. With the progress of Chinese civilization, ca. 100 Apiaceae plants were historically recorded as medicines. Specifically, 12 AMPs (e.g., *Angelica decursiva*, *Bupleurum chinense*, and *Centella asiatica*) were recorded in the known herbal text of China, the “*Divine Husbandman’s Classic of the Materia Medica (Shen Nong Ben Cao Jing)*” in 1st and 2nd century AD [14]. In 1578 and 1848, 24 and 31 AMPs were respectively recorded in the “*Compendium of Materia Medica* and *Illustrated Book on Plants*” [15]. In the 21st century, the number of AMPs has been continually increasing, up to 93 species recorded in the “*Flora of China*” in 2002 [16], and 96 species in the “*Collection of National Chinese Herbal Medicine*” in 2014 [17]. In recent years, 22 species were recorded in the “*Pharmacopoeia of the People’s Republic of China*” [18]. Specifically, 18 species are used with rhizomes and/or roots (Table 1).



**Figure 1.** Apiaceae medicinal plants (AMPs).

**Table 1.** The classification, traditional use, modern pharmacological use, and main metabolites of the 228 AMPs.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
1	<i>Aegopodium alpestre</i> Ledeb.	Xiaoyeqin	Stems and leaves	Dispelling wind, relieving pain, and treating influenza	Treatment of rheumatic diseases, obesity, and hypotensive	Apiole, undecane, and limonene	[19–21]
2	<i>Ammi majus</i> L.	Daamiqin	Fruits	Treatment of vitiligo	\	Furanocoumarins	[16]
3	<i>Anethum graveolens</i> L.	Shiluo	Fruits, leaves, or whole plant	Treatment of bladder inflammation, liver diseases, and insomnia	Antibacterial, antifungal, antioxidant	Alkaloid, terpenoids, and flavonoids	[22]
4	<i>Angelica acutiloba</i> (Siebold & Zucc.) Kitag.	Dongdanggui or ribendanggui	Roots	Treatment of menoxenia and anemia	Hemogenic, analgesic, and sedative activities	Ferulic acid, ligustilide, and angelicide	[23]
5	<i>Angelica amurensis</i> Schischk.	Heishuidanggui or chaoxiandanggui	Roots	\	\	$\alpha$ -pinene, limonene, and sabinene	[1,24]
6	<i>Angelica anomala</i> Avé-Lall.	Xiayedanggui or yixingdanggui	Roots	Dispelling wind, eliminating dampness, and relieving pain	Antioxidant, anti-inflammatory, and antitumor	Isoimperatorin, umbelliferone, and adenosine	[16,25–27]
7	<i>Angelica apaensis</i> R. H. Shan & C. C. Yuan	Faluohai or abadanggui	Roots	Relieving pain, relieving cough and asthma	Bacteriostat, anti-inflammatory	Oxypeucedanin, isoimperatorin, and oxypeucedanin hydrate	[19,28]
8	** <i>Angelica biserrata</i> (R. H. Shan & C. C. Yuan) C. C. Yuan & R. H. Shan	Duhuo or maodanggui	Roots	Dispelling wind, eliminating dampness, and relieving pain	Antitumor, anti-inflammatory, and antioxidant	Coumarins osthole, columbianadin, and volatile oils	[29]
9	<i>Angelica cartilaginosmarginata</i> var. <i>Foliosa</i> C. C. Yuan & R. H. Shan	Shangaoben	Roots	\	\	\	[17]
10	** <i>Angelica dahurica</i> (Fisch. Ex Hoffm.) Benth. & Hook. F. Ex Franch. & Sav.	Baizhi	Roots	Treatment of acne, erythema, and headache	Anti-inflammatory, anti-mutagenic, and antitumor	Scopoletin and psoralen	[18,30–33]
11	** <i>Angelica dahurica</i> cv. Hangbaizhi	Hangbaizhi	Roots	Treatment of headache, toothache, abscess, and furunculosis	Estrogenic, cytotoxic, and anti-inflammatory	Isoimperatorin, imperatorin, and phellopterin	[18,34,35]
12	<i>Angelica dahurica</i> var. <i>Formosana</i> (H. Boissieu) Yen	Taiwanduhuo	Roots	\	Anti-staphylococca	Falcarindiol	[33,34]
13	** <i>Angelica decursiva</i> (Miq.) Franch. & Sav.	Zihuaqianhu	Roots	A remedy for thick phlegm, asthma, and upper respiratory tract infections	Antioxidant and anti-inflammatory potential	Decursin, decursidin, and nodakenetin	[36]
14	<i>Angelica gigas</i> Nakai	Chaoxiandanggui	Roots	Treatment of dysmenorrhea, amenorrhea, and menopause	Anti-platelet effects	Decursin and decursinol angelate	[37,38]

Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
15	<i>Angelica laxifoliata</i> Diels	Shuyedanggui	Roots	Dispelling wind and relieving pain	Treatment of wind-damp pain, lumbus, and knees	Angelicin, $\beta$ -sitosterol, and laxifolin	[16,26,39]
16	<i>Angelica megaphylla</i> Diels	Dayedanggui	Roots	Used as <i>Angelica sinensis</i>	Used as <i>A. Sinensis</i>	Ferulic acid, ligustilide, and angelol	[40,41]
17	<i>Angelica morii</i> Hayata	Fushen	Roots and leaves	Treatment of spleen and stomach, cold cough, and toothache	Used for diarrhea caused by deficiency of spleen and for cough caused by weakness and chill	Imperatorin, isoimperatorin, and phellopterin	[42–44]
18	<i>Angelica nitida</i> H. Wolff	Qinghaidanggui	Roots	Nourishing the blood, regulating menstrual disorder, and relieving pain	\	Isoimperatorin, imperatorin, and cnidilin	[45]
19	<i>Angelica polymorpha</i> Maxim.	Guaiqin or shanqincai	Roots	Dispelling wind and relieving pain	Treatment of stomachache	Coumarins, sesquiterpenoids, and alkaloids	[19,46,47]
20	** <i>Angelica sinensis</i> (Oliv.) Diels	Danggui	Roots	Nourishing the blood, regulating menstrual disorder, and relieving pain	Cardio-cerebrovascular, anti-inflammatory, and antioxidant	Ferulic acid, alkylphthalides, and polysaccharides	[18,48,49]
21	<i>Angelica sinensis</i> var. <i>Wilsonii</i>	Emeidanggui	Roots	Used as <i>Angelica sinensis</i> , relieving pain	Used as <i>Angelica sinensis</i>	Isoimperatorin, coumarin, and oxypeucedanin	[50]
22	<i>Angelica sylvestris</i> L.	Lindanggui	Roots	Relieves rheumatism and sweating, provides detoxification	\	Cnidilide, sedanenolide, and ligustilide	[19]
23	<i>Angelica tsinlingensis</i> K. T. Fu	Qinlingdanggui	Roots	\	\	\	[1]
24	<i>Angelica valida</i> Diels	Wuduhuo or yandanggui	Roots	\	\	\	[1]
25	<i>Anthriscus nemorosa</i> (M. Bieb.) Spreng.	Ciguoeshen	Roots, whole plant, and leaves	Used as <i>Peucedanum praeruptorum</i>	Used as <i>Peucedanum praeruptorum</i>	\	[51]
26	<i>Anthriscus sylvestris</i> (L.) Hoffm.	Eshen	Roots and leaves	Invigorating spleen, replenishing qi, and expelling phlegm	Antitumor, antioxidation, and antisenity	Phenylpropanoids, flavonoids, and steroidal	[19,52]
27	<i>Apium graveolens</i> L.	Hanqin	Whole plant, roots, and rhizome	Dispelling wind, eliminating dampness, and detoxification	Hypertension, hyperlipidemia, and dysuria	Organic acids, apigenin, and volatile oils	[19,53,54]
28	<i>Archangelica brevicaulis</i>	Duanjinggudanggui	Roots	Used as <i>Angelica biserrata</i>	Used as <i>Angelica biserrata</i>	Osthol, imperatorin, and archangelicin	[16,55]
29	<i>Bupleurum angustissimum</i> (Franch.) Kitag.	Xiayechaihu	Roots	\	\	Saikosaponins (a, c, and d), $\beta$ -terpinene, and $\beta$ -thujene	[56]
30	<i>Bupleurum aureum</i> Fisch.	Jinhuangchaihu	Roots	\	\	Saikosaponins (a, c, and d)	[1,57]

Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
31	<i>Bupleurum bicaule</i> Helm	Zhuiyechaihu	Roots	Used as <i>Bupleurum scorzonerifolium</i>	Used as <i>Bupleurum scorzonerifolium</i>	Saikosaponin d, prosaikogenin G, and prosaikogenin F	[16,58,59]
32	<i>Bupleurum candollei</i> Wall. Ex DC.	Chuandianchaihu	Whole plant	Diminishing inflammation, detoxification, dispelling wind, and relieving convulsion	\	Saikosaponin and flavonoids	[16,56]
33	<i>Bupleurum chaishoui</i> R. H. Shan & M. L. Sheh	Chaishou	Roots and rhizome	Used as <i>Bupleurum chinense</i>	Used as <i>Bupleurum chinense</i>	Saikosaponins (a, c, and d)	[60]
34	** <i>Bupleurum chinense</i> DC.	Beichaihu	Roots	Treatment of chronic hepatitis, kidney syndrome, and inflammatory diseases	Anti-allergen, analgesic, and anti-inflammation	Saikosaponins (a, c, and d)	[18,61,62]
35	<i>Bupleurum chinense</i> DC. F. Octoradiatum (Bunge) Shan et Sheh	Baihuashanchaihu	Roots	Used as <i>Bupleurum chinense</i>	Anti-allergen, analgesic, and anti-inflammation	Saikosaponins (a, c, and d)	[63,64]
36	<i>Bupleurum chinense</i> DC. F. Vanheurckii (Muell.-Arg.) Shan et Y. Li	Yantaichaihu	Roots	Used as <i>Bupleurum chinense</i>	Anti-allergen, analgesic, and anti-inflammation	Saikosaponins (a, c, and d)	[63,64]
37	<i>Bupleurum comelynoideum</i> var. <i>Flaviflorum</i> R. H. Shan & Yin Li	Huanghuayazhichaihu	Roots, rhizome, and whole plant	Antipyretic-analgesic effect, choleric, and hepatoprotection	Treating or relieving inflammatory bowel disease	Saikosaponins (a, c, and d), $\beta$ -pinene, and perillen	[65,66]
38	<i>Bupleurum densiflorum</i> Rupr.	Mihuachaihu	Roots	\	\	\	[63]
39	<i>Bupleurum dielsianum</i> H. Wolff	Taibaichaihu	Roots	\	\	\	[63]
40	<i>Bupleurum euphorbioides</i> Nakai	Dabaochaihu	Roots	\	\	Saikosaponins, perillen, and undecanal	[56]
41	<i>Bupleurum exaltatum</i> M. Bieb.	Xinjiangchaihu	Roots	\	\	\	[64]
42	<i>Bupleurum falcatum</i> L.	Sandaochaihu	Roots	\	Treatment of colds and upper respiratory tract infections	Saikosaponins (a, c, and d)	[64,67,68]
43	<i>Bupleurum gansuense</i> S. L. Pan et Hsu	Gansuchaihu	Roots	\	\	\	[56]
44	<i>Bupleurum hamiltonii</i> N. P. Balakr.	Xiaochaihu	Roots or whole plant	Antipyretic-analgesic effect, treatment of chill and fever alternation	Treatment of stomach pain, dysuria, and cough	Kaerophyllin, isokaerophyllin, and ethyl caffeic acid	[69]

Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
45	<i>Bupleurum hamiltonii</i> var. <i>Hamiltonii</i> / <i>Bupleurum tenue</i>	Xiaochaihu	Roots or whole plant	Used as <i>Bupleurum hamiltonii</i> N. P. Balakr.	Used as <i>Bupleurum hamiltonii</i> N. P. Balakr.	\	[70]
46	<i>Bupleurum hamiltonii</i> var. <i>Humile</i> (Franch.) R. H. Shan & M. L. Sheh	Aixiaochaihu	Roots	\	\	\	[64]
47	<i>Bupleurum huizei</i> S. L. Pan sp. Nov.	Huizechaihu	Roots	\	\	\	[64]
48	<i>Bupleurum kaoi</i> T. S. Liu, C. Y. Chao & T. I. Chuang	Taiwanchaihu or gaoshichaihu	Roots	\	Treatment of influenza and fever	Saikosaponin a, c	[64]
49	<i>Bupleurum komarovianum</i> Lincz.	Changbaichaihu	Roots	Used as <i>Bupleurum chinense</i>	Used as <i>Bupleurum chinense</i>	Saikosaponins (a, c, and d) and volatile oils (1-caprylene, limonene, and thymol)	[71,72]
50	<i>Bupleurum krylovianum</i> Schischk. Ex Krylov	Aertaichaihu	Roots	\	\	Saikosaponins (a, c, and d)	[56,57]
51	<i>Bupleurum kunmingense</i> Yin Li & S. L. Pan	Jiuyechaihu	Roots	\	Immunomodulatory	Saikosaponins (a, c, and d), cyclohexanone, and 2-methyldodecane	[56]
52	<i>Bupleurum longicaule</i> var. <i>Amplexicaule</i> C. Y. Wu	Baojingchaihu	Roots	\	\	Saikosaponins (a, c, and d)	[64]
53	<i>Bupleurum longicaule</i> var. <i>Franchetii</i> H. Boissieu	Kongxinchaihu	Roots or whole plant	\	\	Saikosaponins (a, c, and d), cyclohexanone, and myrcene	[56]
54	<i>Bupleurum longicaule</i> var. <i>Giraldii</i> H. Wolff	Qinlingchaihu	Roots	\	\	Saikosaponins (a, c, and d), narcissin, and rutin	[56]
55	<i>Bupleurum longiradiatum</i> Turcz.	Dayechaihu	Roots	Treatment of gout and inflammatory illness	Anti-inflammatory and/or antimicrobial	Thymol, butylidene phthalide, and 5-indolol	[73]
56	<i>Bupleurum luxiense</i> Yin Li & S. L. Pan	Luxichaihu	Roots	\	\	Saikosaponins (a, c, and d), n-heptaldehyde, and octanal	[56]
57	<i>Bupleurum malconense</i> R. H. Shan & Yin Li	Maweichaihu	Whole plant	Hepatoprotection and antipyretic effect	Acute toxicity	Saikosaponins (a, c, and d), rutin, and quercetin	[74–76]
58	<i>Bupleurum marginatum</i> var. <i>Marginatum</i>	Zichaihu or zhuyefangfeng	Whole plant	Hepatoprotection and antipyretic effect	Anti-allergen, analgesic, and anti-inflammatory	Saikosaponins (a, c, and d), rutin, and quercetin	[74,75,77]



Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
59	<i>Bupleurum marginatum</i> var. <i>Stenophyllum</i> (H. Wolff) R. H. Shan & Yin Li	Zhaizhuyechaihu	Whole plant	\	\	Saikosaponins (a, c, and d), chikusaikoside I, II, and 2-methylcyclopentanone	[56]
60	<i>Bupleurum marginatum</i> Wall. Ex DC.	Zhuyechaihu	Whole plant and roots	Hepatoprotection and antipyretic effect	Anti-allergen, analgesic, and anti-inflammatory	Saikosaponins (a, c, and d), rutin, and quercetin	[74,75,77]
61	<i>Bupleurum microcephalum</i> Diels	Maweichaihu	Whole plant and roots	Hepatoprotection and antipyretic effect	Anti-allergen, analgesic, and anti-inflammatory	Saikosaponins (a, c, and d), rutin, and quercetin	[74,75]
62	<i>Bupleurum petiolulatum</i> var. <i>tenerum</i> R. H. Shan & Yin Li	Xijingyoubing-chaihu	Whole plant	Antipyretic-analgesic effect	Anti-inflammatory	\	[63,78]
63	<i>Bupleurum polyclonum</i> Yin Li & S. L. Pan	Duozhichaihu	Roots	\	Anticancer	Saikosaponins (a, c, and d), 4'-O-saikosaponin-a, and fenchane	[56]
64	<i>Bupleurum rockii</i> H. Wolff	Lijiangchaihu	Roots	\	\	Saikosaponins (a, c, and d), thymol, and $\beta$ -guaiene	[56]
65	<i>Bupleurum scorzonifolium</i> f. <i>Longiradiatum</i>	Changsanhong-chaihu	Roots	Used as <i>Bupleurum chinense</i>	Used as <i>Bupleurum chinense</i>	\	[19]
66	<i>Bupleurum scorzonifolium</i> f. <i>Pauciflorum</i>	Shaohuahong-chaihu	Roots	Used as <i>Bupleurum chinense</i>	Used as <i>Bupleurum chinense</i>	\	[19]
67	** <i>Bupleurum scorzonifolium</i> Willd.	Hongchaihu or zhuyechaihu	Roots	Antipyresis, relief of liver issues and menstrual disorders	Used as <i>Bupleurum chinense</i>	Rutin, quercetin, and kaempferol	[18,19]
68	<i>Bupleurum sibiricum</i> var. <i>Jeholense</i> (Nakai) Y. C. Chu ex R. H. Shan & Yin Li	Wulingchaihu	Roots	\	\	\	[1]
69	<i>Bupleurum sibiricum</i> Vest	Xinganchaihu	Roots	Used as <i>Bupleurum chinense</i>	Used as <i>Bupleurum chinense</i>	Saikosaponin a, rutin, and quercetin	[16,79,80]
70	<i>Bupleurum sichuanense</i> S. L. Pan et Hsu.	Sichuanchaihu	Roots	\	\	Saikosaponins (a, c, and d)	[56]
71	<i>Bupleurum smithii</i> H. Wolff	Heichaihu	Roots	Antipyretic-analgesic effect	Anti-inflammatory, immunomodulatory, and anti-hepatic injury	Saponins, volatile oils, and lignans	[81]
72	<i>Bupleurum smithii</i> var. <i>Parvifolium</i> R. H. Shan & Yin Li	Xiaoyeheichaihu	Roots	Relief of liver issues and activation of yang energy	Anti-inflammatory, immunomodulatory, and antitumor	Falcarinol, saponins, and flavonoids	[82]
73	<i>Bupleurum thianschanicum</i> Freyn	Tianshanchaihu	Roots	\	\	Saikosaponins (a, c, and d)	[57]

Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
74	<i>Bupleurum triradiatum</i> Adams ex Hoffm.	Sanfuchaihu	Roots	\	\	\	[1]
75	<i>Bupleurum wenchuanense</i> R. H. Shan & Yin Li	Wenchuanchaihu	Roots	Used as <i>Bupleurum</i>	Used as <i>Bupleurum</i>	Quercetin-3-O- $\alpha$ -L-rhamnoside, quercetin, and rutin	[16,75]
76	<i>Bupleurum yinchowense</i> R. H. Shan & Yin Li	Yinzhouchaihu or hongchaihu	Roots	Antipyresis, relief of liver issues, and activation of yang energy	Used as <i>Bupleurum</i>	Saikosaponins (a, c, and d)	[16,65,83,84]
77	<i>Carum buriaticum</i> Turcz.	Tiangelvzi	Roots and fruits	\	\	\	[5]
78	<i>Carum carvi</i> L.	Zanghuixiang	Roots, fruits, and leaves	Dispelling wind, eliminating dampness, invigorating the stomach, and treating heart disease	Anti-bacterial, antioxidant, and antitumor	Carvone, limonene, and dihydrocarvone	[19,85,86]
79	* <i>Centella asiatica</i> (L.) Urb.	Jixuecao	Whole plant	Clearing heat, promoting diuresis, and treating toxicity	Anti-bacterial, anti-depressive, and neuro-protective	Asiaticoside, madecassoside, and elemene	[18,87]
80	** <i>Changium smyrnioides</i> H. Wolff	Mingdangshen	Roots	Strengthening with tonics, moistening lungs, clearing phlegm, and calming the liver	Immunomodulatory, relieving fatigue, and enhancing adaptability	Cetylic acid, succinic acid, and imperatorin	[18,88]
81	<i>Chuanminshen violaceum</i> M. L. Sheh & R. H. Shan	Chuanmingshen	Roots	Moistening the lungs, clearing phlegm, harmonizing the stomach, and stimulating liquids	Antioxidant, enhancing immunity, and antimutation	Polysaccharides, coumarins, and flavonoids	[89–91]
82	<i>Cicuta virosa</i> L.	Duqin	Roots and rhizome	Expelling phlegm and detoxification	Treatment of osteomyelitis, gout, and rheumatism	P-cymene, cicutoxine, and L-limonene	[17,92]
83	* <i>Cnidium monnieri</i> (L.) Spreng.	Shechuang	Fruits	Dispelling wind, relieving convulsion, treating impotence	Antibacterial, antiviral, and antimutagenesis	Osthole, limonene, and cnidimoside A	[18,93]
84	<i>Cnidium officinale</i>	Dongchuanxiong	Roots	Used as <i>Cnidium monnieri</i>	Used as <i>Cnidium monnieri</i>	\	[1]
85	<i>Comioselinum acuminatum</i> (Franch.) Lavrova	Shuigaoben	Roots	\	\	Sabinene, $\alpha$ -pinene, and aromadendrene	[11]
86	<i>Comioselinum anthriscoides</i> 'Fuxiong'	Fuxiong	Roots	\	\	$\beta$ -bergamotene	[11]
87	<i>Comioselinum tenuisectum</i> (H. Boissieu) Pimenov & Kljuykov	Xiliegaoben	Roots	\	\	\	[94]



Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
88	<i>Conioselinum vaginatum</i> (Spreng.) Thell.	Xinjianggaoben or qiaoshan-xiong	Roots	Dispelling wind, eliminating dampness, and relieving pain	Treatment of common cold due to wind-cold and gastro spasm	Diligustilide, daucoesterol, and palmitic acid	[19,95]
89	<i>Conium maculatum</i> L.	Dushen	Whole plant	Relieving pain and relieving muscular spasm	Treatment of cancer	Coniine, N-methyl-coniine, conhydrine 2-(1-hydroxypropyl)-piperidine	[16,96,97]
90	<i>Coriandrum sativum</i> L.	Husui	Whole plant, fruits, and stems	Invigorating the stomach and promoting eruption	Antibacterial, antifungal, and antioxidant	Petroselinic acid, linoleic acid, and oleic acid	[19,98]
91	<i>Cryptotaenia japonica</i> Hassk.	Sanyeqin	Whole plant	Treatment of weakness, urinary closure, and swelling	Antioxidant, protection of liver, and anticancer	Friedelin, stigmasterol, and apigenin	[19,99,100]
92	<i>Cuminum cyminum</i> L.	Ziranqin	Fruits	Treatment of indigestion and stomach/abdominal pain	Antibacterial, antioxidant, and radical-scavenging properties	$\alpha$ -pinene, 1,8-cineole, and linalool	[19,101]
93	<i>Cyclorhiza peucedanifolia</i> (Franch.) Constance	Nanzhuyehuangengqi	Fruits	Enriching the blood, activating the blood, and regulating menstrual disorder	\	\	[102]
94	<i>Daucus carota</i> L.	Carrot	Fruits	Treatment of ascariasis, enterobiasis, and tapeworm disease	Insecticidal, anti-bacterial, and anticancer	$\alpha$ -pinene, isophorone oxide, and quercetrin	[18,103]
95	<i>Daucus carota</i> var. <i>Carota</i>	Wild carrot	Fruits	Treatment of ascariasis, enterobiasis, and tapeworm disease	Insecticidal, anti-bacterial, and anticancer	$\alpha$ -pinene, $\beta$ -bisabolene, and luteolin	[18,103]
96	<i>Daucus carota</i> var. <i>Sativus</i> Hoffm.	Wild carrot	Roots and basal leaves	Strengthening spleen, treatment of dyspepsia and chronic dysentery	Enhancing immunity, anticancer and anti-aging	Carotene, (1R)- $\alpha$ -pinene, and $\beta$ -carotene	[19,104]
97	<i>Eriocyclus albescens</i> (Franch.) H. Wolff	Dianqianghuo	Roots	\	\	\	[1]
98	<i>Eryngium foetidum</i> L.	Ciqin	Whole plant	Diuresis, treatment of dropsy and snakebite	Bacteriostat, diminishing of inflammation, and promotion of detumescence	Lanolin alcohol, carotene, and <i>n</i> -nonyl aldehyde	[19,105]
99	<i>Ferula bungeana</i> Kitag.	Yingawei	Whole plant and seeds	Heat clearing and detoxifying, relieving pain and expelling phlegm, and arresting coughing	Treatment of cold, bronchopneumonia, and pulmonary tuberculosis	Anisole, <i>d</i> -fenchone, and limonen	[19,106]
100	<i>Ferula caspica</i> M. Bieb.	Lihaiawei	Roots and resin	Eliminating stagnated food, relieving dyspepsia, insecticide	Treatment of toxicity	Umbelliprenin, farnesyl alcohol, and umbelliferone	[107]

Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
101	<i>Ferula conocaula</i> Korovin	Yuanzhuijingawei	Resin, roots, and rhizome	Eliminating stagnated food, insecticide, treatment of abdominal mass	Anticancer and treatment of influenza	Umbelliprenin, fezelol, and feterin	[107]
102	<i>Ferula feruloides</i> (Steud.) Korovin	Xiangawei	Roots and resin	Treatment of chilliness, and heart and abdominal pain	Insecticidal, bacteriostat, and antitumor	$\alpha$ -pinene, farnesene and toluene	[108,109]
103	** <i>Ferula fukanensis</i> K. M. Shen	Fukangawei	Resin	Eliminating stagnated food, relieving dyspepsia, insecticide	Treatment of stomach disease, rheumatism, and joint pain	Ferulic acid, guaiol, and ethyl-p-hydroxybenzoate	[18,19,110–112]
104	<i>Ferula jaeschkeana</i> Vatke	Zhongyaawei	Resin of overground part	Eliminating stagnated food, insecticide, treatment of tumors, wounds, and peptic ulcers	Antifertility	Jaeschkeanadiol, $\alpha$ -pinene, and $\beta$ -pinene	[107]
105	<i>Ferula krylovii</i> Korovin	Tuoliawei	Resin	Eliminating stagnated food, insecticide	\	Fekrynol, ferukrin and fekrynol acetate	[107]
106	<i>Ferula lehmannii</i> Boiss.	Daguoawei	Resin	Detoxification, deodorization, and insecticide	Treatment of gastropathy, rheumatism, and arthralgia	Lehmannolone, sinkianone, and lehmannolone A	[16,113]
107	<i>Ferula moschata</i> (Reinsch) Koso-Pol.	Shexiangawei	Roots	Sedative, treatment of spasmodic and hysteria	Suppresses the replication of human immunodeficiency virus in H9 lymphocytes and suppresses the production of cytokine	Fezelol, fesumtuorin A, and fesumtuorin B	[107]
108	<i>Ferula olivacea</i> (Diels) H. Wolff ex Hand.-Mazz.	Lanlvawei	Resin	Wind-heat dispersing, expelling phlegm, and arresting cough	\	\	[16]
109	** <i>Ferula sinkiangensis</i> K. M. Shen	Xinjiangawei	Resin	Eliminating stagnated food, detoxification, insecticide	Antioxidant, antitumor, and antiviral	Ferulic acid, fekrynol, and lehmannolone	[16,18,114,115]
110	<i>Ferula songarica</i> Pall. Ex Schult.	Zhungaewei	Resin and whole plant	Eliminating stagnated food, insecticide	\	2,4-dihydroxyacetophenone, 3,3', 4,4'-biphenyltetracarboxylic acid, and $\Delta^3$ -carene	[116]
111	<i>Ferula teterrima</i> Kar. & Kir.	Chouawei	Resin	Eliminating stagnated food, insecticide	Treatment of malaria and dysentery	Feterin, badrakemin, and badrakemin acetate	[116]
112	* <i>Foeniculum vulgare</i> Mill.	Xiaohuixiang	Fruits, roots, stems, leaves, and whole plant	Dispelling wind, relieving pain, and harmonizing the stomach	Bacteriostat, anti-inflammatory, and insecticide	Trans-anethole, estragole, and anisaldehyde	[18,19,117,118]

Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
113	** <i>Glehnia littoralis</i> F. Schmidt ex Miq.	Beishashen	Roots	Heat clearing and detoxifying, diminishing inflammation, expelling phlegm, and arresting cough	Anti-inflammatory, bacteriostat, and antitumor	Phenyllactic acid, catechol, and quercetin	[18,119]
114	<i>Hansenia oviformis</i> (R. H. Shan) Pimenov & Kljuykov	Luanyeqianghuo	Rhizome, roots, and leaves	Treatment of rheumatic arthralgia, cold due to wind-cold, and headache	\	\	[16,102]
115	<i>Heracleum barmanicum</i> Kurz	Yinduduhuo	Roots	Treatment of cold abdominalgia	\	\	[16]
116	<i>Heracleum candicans</i> Wall. Ex DC.	Baiyunhua	Roots	Dispelling wind, eliminating dampness, and relieving pain	Treatment of cold headache	Bergapten, heraclenin, and imperatorin	[19,120]
117	<i>Heracleum dissectifolium</i> K. T. Fu	Duolieduhuo	Roots	Dispelling wind, eliminating dampness, and relieving pain	\	\	[16]
118	<i>Heracleum fargesii</i> H. Boissieu	Chengkouduhuo	Roots	\	\	\	[17]
119	<i>Heracleum franchetii</i> M. Hiroe	Jianyeduhuo	Roots and rhizome	\	\	\	[121,122]
120	<i>Heracleum hemsleyanum</i>	Niuweiduhuo	Roots and rhizome	Dispelling wind, eliminating dampness, and relieving pain	Antioxidant, anti-inflammatory, and antitumor	$\beta$ -pinene, $\alpha$ -pinene, and (1S)-6,6-dimethyl-2-methylene-bicyclo [3.1.1] heptane	[26,27,123,124]
121	<i>Heracleum hemsleyanum</i> Diels	Beiduhuo or dahuo	Roots and rhizome	Dispelling wind, eliminating dampness, and relieving pain	Antioxidant, anti-inflammatory, and antitumor	Osthole, columbianadin, and columbianetin	[26,27]
122	<i>Heracleum henryi</i> H. Wolff	Nanguaqi	Roots	Clearing and activating the channels and collaterals, relieving pain and scattered stasis	\	Turgeniifolin B, turgeniifolin C, and bergapten	[125]
123	<i>Heracleum millefolium</i> var. <i>Millefolium</i>	Qianyeduhuo or zangdang-gui	Roots and rhizome	Detumescence, treating masses, and treating leprosy	\	\	[102,121,122]
124	<i>Heracleum moellendorffii</i> Hance	Duanmaoduhuo	Roots and rhizome	Clearing and activating the channels and collaterals, relieving pain and scattered stasis	Bacteriostat	$\beta$ -pinene, $\alpha$ -pinene, and pentadecane	[123,125–127]
125	<i>Heracleum oreocharis</i> H. Wolff	Shandiduhuo	Roots	\	\	\	[122]
126	<i>Heracleum rapula</i> Franch.	Baiyunhua	Roots	Clearing and activating the channels and collaterals, relieving pain and scattered stasis	Bacteriostat, treatment of asthma, and chronic bronchitis	Osthole, marmesin, and imperatorin	[19,125,128]

Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
127	<i>Heracleum scabridum</i> Franch.	Dianbaizhi or caoduhuo	Roots, rhizome, and fruits	Treatment of common cold due to wind-cold, headache, cough, and asthma	\	Heraclenol, oxypeucedanin-hydrate, and byakangelicin	[129–131]
128	<i>Heracleum souliei</i> H. Boissieu	Xiaoduhuo	Roots	\	\	Bergapten	[120,122]
129	<i>Heracleum stenopteryum</i> Diels	Xiachiduhuo	Roots	Treatment of cold and rheumatism	\	Bergapten, isopimpinellin, and sphondin	[16,132]
130	<i>Heracleum tiliifolium</i> H. Wolff	Duanyeduhuo	Roots	Dispelling wind, eliminating dampness, and relieving pain	\	\	[16]
131	<i>Heracleum vicinum</i> H. Boissieu	Pingjieduhuo	Roots	Used as <i>Notopterygium incisum</i>	\	\	[121,122]
132	<i>Heracleum wenchuanense</i> F. T. Pu & X. J. He	Wenchuanduhuo	Roots	\	\	\	[122]
133	<i>Heracleum wolongense</i> F. T. Pu & X. J. He	Wolongduhuo	Roots	\	\	\	[1,122]
134	<i>Heracleum yungningense</i> Hand.-Mazz.	Niuweiduhuo	Roots and rhizome	Treatment of waist and knee pain, limb spasm, and leucoderma	\	Pimpinellin, angelicin, and isobergapten	[26,133]
135	<i>Hydrocotyle himalaica</i> P. K. Mukh.	Binghuatianhusui	Whole plant	Heat clearing, detoxifying, and eliminating dampness	\	Asiaticoside, madecassoside, and quercetin	[134,135]
136	<i>Hydrocotyle hookeri</i> subsp. <i>Chinensis</i> (Dunn ex R. H. Shan & S. L. Liou) M. F. Watson & M. L. Sheh	Tongqiancao	Whole plant	Relieving pain, diuresis, and removing dampness	Antiviral, antitumor, and anti-bacterial	Flavonoids, triterpenes, and volatile oils	[16,129,135]
137	<i>Hydrocotyle nepalensis</i> Hook.	Hongmaticao	Whole plant	Clearing heat and promoting diuresis, dissolving stasis, and hemostasis and detoxification	Antiviral, antitumor, and anti-bacterial	Flavonoids, triterpenes, and volatile oils	[16,135]
138	<i>Hydrocotyle sibthorpioides</i> Lam.	Xiaojinqiancao	Whole plant	Heat clearing, diuresis, and detumescence	Anti-ulcer, antilipemic, and antiviral	Quercetin, isorhamnetin, and asiaticoside	[135,136]
139	<i>Hydrocotyle sibthorpioides</i> var. <i>batrachium</i> (Hance) Hand.-Mazz. Ex R. H. Shan	Tianhusui or potongqian	Whole plant	Heat clearing and detoxifying, eliminating dampness, and diuresis	Anti-ulcer, spasmolysis, and anti-inflammatory	Benzene propane nitrile, phytol, and caryophyllene oxide	[16,137,138]
140	<i>Hydrocotyle wilfordii</i> Maxim.	Yutengcao	Whole plant	As <i>Hydrocotyle nepalensis</i> Hook.	As <i>Hydrocotyle nepalensis</i> Hook.	Asiaticoside, madecassoside, and quercetin	[134,135]
141	<i>Hymenidium chloroleucum</i> (Diels) Pimenov & Kljuykov	Xizangdian-gaoben	Roots or whole plant	Regulating flow of qi, invigorating the stomach, and activating blood	Anti-inflammatory, analgesia, and nutritious function	Nobiletin, falcariindiol, and isoliquiritigenin	[19,139,140]

Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
142	<i>Hymenidium davidii</i> (Franch.) Pimenov & Kljuykov	Songpanlengziqin	Roots	\	\	\	[141]
143	<i>Hymenidium delavayi</i> (Franch.) Pimenov & Kljuykov	Lijianggaoben	Roots	\	\	\	[1,6]
144	<i>Hymenidium lindleyanum</i> (Klotzsch) Pimenov & Kljuykov	Tianshanlengziqin	Roots	Treatment of hypertension, coronary heart disease, and altitude stress	\	Bergapten, isoimperatorin, and oxypeucedanin	[142]
145	<i>Kitagawia formosana</i> (Hayata) Pimenov	Taiwanqianhu	Roots	\	\	\	[1]
146	<i>Kitagawia macilenta</i> (Franch.) Pimenov	Xilieqianhu	Roots	Expelling phlegm	\	\	[143]
147	<i>Kitagawia terebinthacea</i> (Fisch. Ex Trevir.) Pimenov	Shifangfeng	Roots	Clearing heat and dispelling wind, calming the adverse-rising energy, and expelling phlegm	Treatment of cold and cough, bronchitis, and cough during pregnancy Inhibition of rhythmic uterine contractions, Scavenging oxygen free radicals, and anti-lipid peroxidation Bacteriostat, treatment of common cold due to wind-cold, generalized pain, and cough	Isoepoxybuterixin	[19]
148	<i>Levisticum officinale</i> W. D. J. Koch	Oudanggui	Roots	Diuresis, invigorating the stomach, and expelling phlegm	Diuresis, invigorating the stomach, and expelling phlegm	Ligustilide, $\alpha$ -phellandrene, and $\beta$ -phellandrene	[19,144]
149	<i>Libanotis buchtormensis</i> (Fisch.) DC.	Yanfeng	Roots	Treating wind chill, dispelling wind dampness, and relieving pain	Treating wind chill, dispelling wind dampness, and relieving pain	Falcarinone, isoimperatorin, and xanthotoxin	[19,145]
150	<i>Libanotis iliensis</i> (Lipsky) Korovin	Xiyefangfeng	Roots	Expel wind-cold pathogens, thermolysis, and relieving pain	Expel wind-cold pathogens, thermolysis, and relieving pain	Archangelin and iliensin	[19]
151	<i>Libanotis lancifolia</i> K. T. Fu	Yanfeng	Roots	Divergent wind chill, dispelling wind-damp, and relieving pain	Divergent wind chill, dispelling wind-damp, and relieving pain	Falcarinone, isoimperatorin, and xanthotoxin	[19,145]

Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
152	<i>Libanotis laticalycina</i> R. H. Shan & M. L. Sheh	Shuifangfeng	Roots	Dispelling wind, antispasmodic, and relieving pain	Analgesic, sedative, and anti-inflammatory	Octanal, hexanal, and 2-pentylfuran	[16,146,147]
153	<i>Libanotis seseloides</i> (Fisch. & C. A. Mey. Ex Turcz.) Turcz.	Xiangqin	Roots	Eliminating dampness, activating spleen, and promote blood circulation	Treatment of obstruction, dysentery, and sores	Edultin	[19]
154	<i>Libanotis sibirica</i> (L.) C. A. Mey.	Beixiangqin	Roots	\	\	\	[1]
155	<i>Libanotis spodotrichoma</i> K. T. Fu	Changchongqi	Roots	Treating wind chill, dispelling wind dampness, and relieving pain	Bacteriostat, treatment of common cold due to wind-cold, generalized pain, and cough	Falcarinone, isoimperatorin, and xanthotoxin	[19,145]
156	<i>Ligusticopsis brachyloba</i> (Franch.) Leute	Maoqianhu	Roots	Sudation, relieving pain, and dispelling wind	Treatment of headache, dizziness, arthralgia, and tetanus	$\alpha$ -pinene, $\beta$ -pinene, and sabinene	[148–150]
157	<i>Ligusticopsis daucooides</i> (Franch.) Lavrova & Kljuykov	Yubaogaoben	Roots	\	\	\	[1,94]
158	<i>Ligusticopsis likiangensis</i> (H. Wolff) Lavrova & Kljuykov	Meimaigaoben	Roots	\	\	\	[1,94]
159	** <i>Ligusticum chuanxiong</i> Hort.	Chuanxiong	Roots, rhizome, stems, and leaves	Activating blood, relieving pain, and dispelling wind	Anti-inflammatory, antioxidant, and antitumor	Abietene, tetramethylpyrazine, and glucose	[18,19,151]
160	** <i>Ligusticum jeholense</i> Nakai et Kitag.	Liaogaoben	Roots and rhizome	Dispelling wind, dispersing cold, and eliminating dampness	Anti-inflammatory, sedative, and anti-ulcer	Ferulic acid, isoferulic acid, and daucosterol	[18,19,152,153]
161	<i>Ligusticum pteridophyllum</i> Franch.	Jueyegaoben	Roots	Dispelling wind, relieving pain, and eliminating dampness	Treatment of cold due to wind-cold and migraine	Asaricin, $\beta$ -sitosterol, and daucosterol	[26,154]
162	** <i>Ligusticum sinense</i> Oliv.	Baogen	Roots, rhizome, and tuber	Expelling wind-cold pathogens, eliminating dampness, and relieving pain	Anti-inflammatory, central inhibitory, and anti-thrombotic effects	3-butylphthalide, ophthalonide, and neophthalonide	[18,155]
163	<i>Ligusticum tenuissimum</i> (Nakai) Kitagawa	Gaoben	Roots and rhizome	Used as <i>ligusticum sinense</i> Oliv. Treatment of wind chill, wind-cold headache, and diarrhea	Analgesia and sedation	Ferulic acid	[19,94,156]

Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
164	<i>Meeboldia delavayi</i> (Franch.) W. Gou & X. J. He	Dianqin	Roots	Treatment of cold, fever, and headache	\	\	[16]
165	<i>Nothosmyrnum japonicum</i> var. <i>Japonicum</i>	Baibaoqin	Roots	\	Sedation and analgesia	\	[16]
166	<i>Nothosmyrnum japonicum</i> var. <i>Sutchuensis</i> H. Boissieu**	Chuanbaibaoqin	Roots	\	Sedation and analgesia	\	[16]
167	<i>Notopterygium franchetii</i> H. De Boiss.**	Kuanyeqianghuo	Roots and rhizome	Treating wind chill, dispelling wind, and eliminating dampness	Anti-inflammatory, analgesic, and antiviral	Nodakenin, ferulic acid, and bergamot lactone	[18,157,158]
168	<i>Notopterygium incisum</i> Ting ex H. T. Chang	Qianghuo	Roots and rhizome	Treating wind chill, dispelling wind, and eliminating dampness	Anti-inflammatory, analgesic, and antiviral	Nodakenin, notopterol, and isoimperatorin	[18,158]
169	<i>Oenanthe benghalensis</i> Benth. & Hook.	Shaohuashuiqin	Roots and whole plant	Used as <i>Oenanthe javanica</i> (Blume) DC.	Used as <i>Oenanthe javanica</i> (Blume) DC. Enhancing immunity, antiarrhythmic, and hypoglycemic	\	[17,159]
170	<i>Oenanthe javanica</i> (Blume) DC.	Shuiqin	Roots, stems, and whole plant	Heat clearing, detoxification, and removing liver-fire	Used as <i>Oenanthe javanica</i> (Blume) DC.	Phytic acid, $\gamma$ -terpinene, and caryophyllene	[19,160]
171	<i>Oenanthe linearis</i> subsp. <i>Rivularis</i> (Dunn) C. Y. Wu & F. T. Pu	Yeshuiqin	Roots and whole plant	Used as <i>Oenanthe javanica</i> (Blume) DC.	Used as <i>Oenanthe javanica</i> (Blume) DC.	\	[17]
172	<i>Osmorhiza aristata</i> var. <i>Laxa</i> (Royle) Constance & R. H. Shan	Xianggenqin	Roots	Treating wind chill and sudation, and relieving pain	\	\	[16]
173	<i>Ostericum citriodorum</i> (Hance) C. C. Yuan & R. H. Shan	Geshanxiang	Roots and whole plant	Activating blood, dissolving stasis, and dispelling wind	Expectorant, anti-inflammatory, and bacteriostat	Isoapiole, panaxynol, and myristicin	[19,161–163]
174	<i>Ostericum grosseserratum</i> (Maxim.) Kitag.	Dachishanqin	Roots	Activating spleen, dispersing cold, invigorating spleen, and replenishing qi	\	Octanal, $\beta$ -pinene, and myristic acid	[16,164,165]
175	<i>Ostericum sieboldii</i> (Miq.) Nakai	Shanqin	Roots	\	\	\	[166–168]
176	<i>Peucedanum dielsianum</i> Fedde ex H. Wolff	Chuanfangfeng	Roots and rhizome	Relieving pain, dispelling wind, and eliminating dampness	\	Isoimperatorin, Phellopterin, and 9-octadecenoic acid	[19,169,170]
177	<i>Peucedanum dissolutum</i> (Diels) H. Wolff	Yanfeng	Roots	\	\	\	[1]
178	<i>Peucedanum harry-smithii</i> var. <i>Subglabrum</i>	Yingqianhu	Roots	Used as <i>Peucedanum praeruptorum</i> ; alleviating asthma, reducing phlegm, and heat elimination	Treatment of bronchitis, hypertension, and coronary heart disease	Psoralen, bergapten, and xanthotoxin	[171–174]



Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
179	<i>Peucedanum japonicum</i> Thunb.	Binhaiqianhu	Roots	Clearing heat, relieving cough, and diuresis	Antipyresis, analgesia, and anti-inflammatory	Peucedanol, umbelliferone, and $\beta$ -pinene	[19,175,176]
180	<i>Peucedanum ledebourielloides</i> K. T. Fu	Huashanqianhu	Roots	\	\	\	[1,168]
181	<i>Peucedanum longshengense</i> R. H. Shan & M. L. Sheh	Nanlingqianhu	Roots	\	\	\	[1]
182	<i>Peucedanum mahanense</i> R. H. Shan & M. L. Sheh	Fangfeng	Roots	Expelling phlegm	\	\	[143]
183	<i>Peucedanum medicum</i> Dunn	Huazhongqianhu	Roots	Expelling phlegm, alleviating asthma and cough, and arresting convulsion	Anticoagulation, antioxidant, and antibacterial	2-methoxy-4-vinylphenol, <i>p</i> -menthan-1-ol, and <i>cis</i> - $\alpha$ -bisabolene	[19,177,178]
184	<i>Peucedanum medicum</i> var. <i>Gracile</i> Dunn ex R. H. Shan & M. L. Sheh	Yanqianhu	Roots and rhizome	Expelling phlegm, alleviating asthma and cough, and arresting convulsion	Anticoagulation, antioxidant, and antibacterial	Isoimperatorin, phellorerin, and bergapten	[19,177,179]
185	<i>Peucedanum medicum</i> var. <i>Medicum</i>	Huazhong-qianhu	Roots and rhizome	Expelling phlegm, alleviating asthma and cough, and arresting convulsion	Anticoagulation, antioxidant, and antibacterial	2-methoxy-4-vinylphenol, <i>p</i> -menthan-1-ol, and <i>cis</i> - $\alpha$ -bisabolene	[19,177,178]
186	** <i>Peucedanum praeruptorum</i> Dunn	Qianhu	Roots	Treating gas, clearing heat, and reducing phlegm	Anticoagulation, antioxidant, and anticancer	Praeruptorin A, praeruptorin B, and scopoletin	[18,180]
187	<i>Peucedanum shanianum</i> F. L. Chen & Y. F. Deng	Hongqianhu	Roots	Relieving asthma, expelling phlegm, and treating spasmolysis	Anti-inflammatory, antiallergic, and anti-ulcer	Sinodioides A, deltoin, and (+)-pareruptorin A	[181–184]
188	<i>Peucedanum turgenifolium</i> H. Wolff/ <i>Peucedanum pulchrum wawrae</i> (H. Wolff) S. W. Su ex M. L. Sheh	Yaqianhu	Roots and whole plant	Expelling phlegm, antiechic, and dispersing wind-heat	Smooth muscle spasmolysis	Turgenifolin A, turgenifolin B, and bergapten	[19,184,185]
189	<i>Peucedanum wulongense</i> R. H. Shan & M. L. Sheh	Taishanqianhu	Roots	Antiechic and expelling phlegm	Analgesia, sedation, and anti-inflammatory	Peucedanocoumarin, d-laserpitin, and bergapten	[16,168,186]
190	<i>Phlojodicarpus sibiricus</i> (Steph. Ex Spreng.) Koso-Pol.	Wulongqianhu	Roots	\	\	\	[1]
191	<i>Physospermopsis alepidioides</i> (H. Wolff & Hand.-Mazz.) R. H. Shan	Zhangguoqin	Roots	\	\	\	[1]
192	<i>Physospermopsis delavayi</i> (Franch.) H. Wolff	Quanyedianxiong	Roots	\	\	\	[1]
193		Dianxiong	Roots	\	\	\	[1]

Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
194	<i>Pimpinella anisum</i> L.	Huiqin	Fruits	Warming meridian and diuresis	Treatment of paralysis, facial paralysis, and migraine	Anisaldehyde, anisole, and (E)-anethole	[187–191]
195	<i>Pimpinella candolleana</i> Wight & Arn.	Xingyefangfeng	Roots or whole plant	Warming spleen and stomach for dispelling cold, relieving pain, and dispelling wind	Relieving muscular spasm, antiviral, and antibacterial	$\alpha$ -zingiberene, pregeijerene, and $\beta$ -elemene	[19,192–194]
196	<i>Pimpinella coriacea</i> (Franch.) H. Boissieu	Geyehuiqin	Whole plant	Warming spleen and stomach for dispelling cold, dispelling wind, and eliminating dampness, and activating blood	\	\	[195]
197	<i>Pimpinella diversifolia</i> DC.	Yiyehuiqin	Whole plant	Expelling phlegm, activating blood, relieving pain, and removing toxicity for detumescence	Anti-inflammatory, antitumor, and anti-tuberculosis	1H-benzocycloheptene, sesquiphellandrene, and $\beta$ -chamigrene	[196–198]
198	<i>Pimpinella diversifolia</i> var. <i>Diversifolia</i>	Yiyehuiqin	Roots or whole plant	Invigorating stomach, dispersing accumulations, and antidiarrheic	Anti-inflammatory, antitumor, and anti-tuberculosis	1H-benzocycloheptene, sesquiphellandrene, and $\beta$ -chamigrene	[19,196–198]
199	<i>Pimpinella thellungiana</i> H. Wolff	Yanghongshan	Roots or whole plant	Warming spleen and stomach for dispelling cold, benefiting qi and nourishing blood, and coordinating yin and yang	Hypotensive, hypolipidemic, and modulates and improves cellular immunity	Protocatechuic acid, gallic acid, and neochlorogenic acid	[199–203]
200	<i>Pleurospermopsis bicolor</i> (Franch.) Jing Zhou & J. Wei	erselengziqin	Whole plant	Warming spleen and stomach for dispelling cold, benefiting qi and nourishing blood, and coordinating yin and yang	Hypotensive, antilipemic, and modulates and improves cellular immunity, antimicrobial	Chlorogenic acid, isochlorogenic acid A, and apigenin-7-O- $\beta$ -D-glucuronopyranoside	[199,201,202]
201	<i>Pleurospermum aromaticum</i> W. Sm.	fangxiang-lengziqin	Whole plant	\	\	\	[1]
202	<i>Pleurospermum giraldii</i> Diels	Taibaidian-gaoben	Whole plant and seeds	Warming spleen, digesting food, and treating vaginal discharge	Inhibition of smooth muscle contraction and releasing intestinal smooth muscle spasm	Carvone, n-triactanol, and $\gamma$ -sitosterol	[19,204–206]
203	<i>Pleurospermum rivolorum</i> (Diels) K. T. Fu & Y. C. Ho	Shetouqianghuo	Roots or whole plant	Tonifying the kidney	\	\	[1,102]
204	<i>Pternopetalum leptophyllum</i> (Dunn) Hand.-Mazz.	Baoyenang-banqin	Whole plant	\	\	\	[16]

Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
205	<i>Pternopetalum vulgare</i> var. <i>Vulgare</i>	Wupiqing	Roots or whole plant	Treatment of lumbago	\	\	[19]
206	<i>Sanicula astrantiifolia</i> H. Wolff ex Kretschmer	Wupifeng or xiaoheiyao	Whole plant	Tonifying the kidney and lung, treating tuberculosis and kidney vacuity lumbar pain	Antioxidant, antibacterial, and bacteriostat	Total flavonoids, rutin, and polysaccharides	[207–209]
207	<i>Sanicula caerulescens</i> Franch.	Dafeijincao	Whole plant	Dispelling wind, treating phlegm, and promoting blood circulation for regulating menstruation	Expectorant, antitubercular, and anti-inflammatory	Angelicin, isoferulaldehyde, and 12-hydroxybakuchiol	[19,210,211]
208	<i>Sanicula chinensis</i> Bunge	Shanqincai	Whole plant	Detoxification, hemostasis, and treatment of throat pain	Antiviral	\	[129,212–214]
209	<i>Sanicula elata</i> Buch.-Ham. Ex D. Don	Sanyeqi	Whole plant	Used as <i>Sanicula lamelligera</i>	Antiviral	Oleanane saponins, saponins, and microelement	[212–217]
210	<i>Sanicula lamelligera</i> Hance	Dafeijincao	Whole plant	Dispelling wind, treating phlegm, and promoting blood circulation for regulating menstruation	Expectorant, antitubercular, and anti-inflammatory	Angelicin, isoferulaldehyde, and 12-hydroxybakuchiol	[19,210,211]
211	<i>Sanicula orthacantha</i> S. Moore	Heiejiaoban	Roots or whole plant	Heat clearing and detoxifying, treatment of traumatic injury	\	\	[16]
212	<i>Sanicula orthacantha</i> var. <i>Brevispina</i> H. Boissieu	Yajiaoqi	Whole plant	Heat clearing and detoxifying, treatment of traumatic injury	\	\	[16]
213	** <i>Saposhnikovia divaricata</i> (Turcz.) Schischk.	Fangfeng	Roots	Dispelling wind, removing dampness to relieve pain, and arresting convulsion	Analgesia, sedation, and anti-inflammatory	Prim- <i>o</i> -glucosylcimifugin, 5- <i>O</i> -methylvisamitol glycoside, and cimifugin	[18,218,219]
214	<i>Selinum cryptotaenium</i> H. Boissieu	Linagshechuang	Roots	\	\	\	[1]
215	<i>Semenovia montana</i> Kamelin & V. M. Vinogr.	Lieyeduhuo	Roots	\	\	\	[122]
216	<i>Seseli delavayi</i> Franch.	Yunfangfeng	Roots	Dispelling wind, removing dampness, and relieving pain	\	\	[19]
217	<i>Seseli mairei</i> var. <i>Mairei</i>	Yunfangfeng	Roots and rhizome	Dispelling wind, removing dampness, and relieving pain	Antipyretic, analgesic, and anti-inflammatory	Sphondin, bergapten, and isopimpinellin	[19,220–222]
218	<i>Seseli yunnanense</i> Franch.	Chuanfangfeng	Roots and rhizome	Dispelling wind, removing dampness, and relieving pain	Antipyretic, analgesic, and anti-inflammatory	Falcarindiol, falcarinol, and glycerol monolinoleate	[19,220,221,223]
219	<i>Seselopsis tianschanica</i> Schischk.	Xiguiqin	Roots	Treatment of fall injury, anemia, and other diseases	Treatment of nasopharynx cancer	\	[16]

Table 1. Cont.

No.	Plant Species	Local Name in Chinese	Parts of Plant Used	Traditional Use	Modern Pharmacological Use	Main Metabolites	References
220	<i>Sium suave</i> Walter	Caogaoben	Whole plant	Dispersing cold, relieving headache, and decreasing blood pressure	\	\	[16,224]
221	<i>Spuriopimpinella arguta</i> (Diels) X. J. He & Z. X. Wang	Jianchidayeqin	Roots and whole plant	\	\	\	[195]
222	<i>Tongoloo silaifolia</i> (H. Boissieu) H. Wolff	Taibaisanqi	Roots	Stopping bleeding, relieving pain, and activating blood	Treatment of traumatic injury, trauma bleeding, and rheumatic pain	Suberosin, crenulatin, and isoimperatorin	[19,225,226]
223	<i>Tongoloo stewardii</i> H. Wolff	Gulingdongeqin	Roots	\	\	\	[1]
224	<i>Torilis japonica</i> (Houtt.) DC.	Heshi	Fruits and roots	Lumbricide ascaricide and external antiphlogistic agent	\	Essential oil	[19]
225	<i>Torilis scabra</i> (Thunb.) DC.	Huananheshi	Fruits or whole plant	Activating blood, insecticide, and antidiarrheal	Bacteriostat	Cyclohexene, 6,6-dimethyl-bicyclo [3.1.1] heptane-2-carboxaldehyde, and endo-borneol	[19,195,227]
226	<i>Trachyspermum ammi</i> (L.) Sprague.	Ayuwei	Fruits	Dispersing cold, relieving pain, and treating indigestion	Antibacterial, antimicrobial, and antifungal	thymol, $\rho$ -cymene, and $\beta$ -pinene	[19,188,228–231]
227	<i>Vicatia thibetica</i> H. Boissieu	Xigui	Roots	Dispelling wind, eliminating dampness, and dispelling cold	Anti-fatigue, antioxidant, and enhancing immunity	Umbelliferone, bergapten, and ferulic acid	[232–234]
228	<i>Visnaga daucooides</i> Gaertn.	Amiqin	Fruits	Treatment of coronary artery disease, such as coronary thrombosis	Treatment of renal colic, angina pectoris, and urinary calculi	Khellin, visnagin, and khellol glycoside	[16,235]

Note: \* means the plant reported in “*Pharmacopoeia of the People’s Republic of China* (2020)”, \*\* means the plant roots used as medicine reported in “*Pharmacopoeia of the People’s Republic of China* (2020)” [18].

#### 4. Classification of AMPs Species

To our best knowledge, a total of 228 AMPs used as TCMs were collected from previously published studies and books (Table 1). Based on the traditionally used medicinal parts, the 228 AMPs were categorized into six classes, including 51 species (21 genera) used with the whole plants (i.e., rhizome and/or root, stem, and leaf), 184 species (44 genera) used with rhizomes and/or roots, 5 species (5 genera) used with stems, 9 species (8 genera) used with leaves, 17 species (14 genera) used with fruits, and 1 species (single genus) used with seeds.

Specifically, the 51 species (21 genera) used with the whole plants include *Anethum*, *Anthriscus*, *Apium*, *Bupleurum*, *Centella*, *Conium*, *Coriandrum*, *Cryptotaenia*, *Eryngium*, *Ferula*, *Foeniculum*, *Hydrocotyle*, *Oenanthe*, *Peucedanum*, *Pimpinella*, *Pleurospermum*, *Pternopetalum*, *Sanicula*, *Sium*, *Spuriopimpinella*, and *Torilis* genera. In particular, *Sanicula* (e.g., *S. astantiifolia*, *S. caerulea*, *S. chinensis*), *Hydrocotyle* (e.g., *H. himalaica*, *H. hookeri*, and *H. nepalensis*),

and *Pimpinella* (e.g., *P. candolleana*, *P. coriacea*, and *P. diversifolia*) genera plants are usually used as whole plants.

The 184 species (44 genera) used with the rhizomes and/or roots, which make up the majority of AMPs, include *Angelica*, *Anthriscus*, *Apium*, *Archangelica*, *Bupleurum*, *Carum*, *Changium*, *Chuanminshen*, *Cicuta*, *Cnidium*, *Conioselinum*, *Daucus*, *Eriocyclus*, *Ferula*, *Foeniculum*, *Glehnia*, *Heracleum*, *Hymenidium*, *Kitagawia*, *Levisticum*, *Libanotis*, *Ligusticopsis*, *Ligusticum*, *Meeboldia*, *Nothosmyrnum*, *Oenanthe*, *Osmorhiza*, *Ostericum*, *Peucedanum*, *Phlojodicarpus*, *Physospermopsis*, *Pimpinella*, *Pleurospermum*, *Pternopetalum*, *Sanicula*, *Saposhnikovia*, *Selinum*, *Semenovia*, *Seseli*, *Seselopsis*, *Spuriopimpinella*, *Tongoloo*, *Torilis*, and *Vicatia* genera. Specifically, *Angelica* (e.g., *A. biserrata*, *A. dahurica*, and *A. sinensis*), *Bupleurum* (e.g., *B. bicaule*, *B. chinense*, and *B. scorzonifolium*), and *Ligusticum* (*L. chuanxiong*, *L. jeholense*, and *L. sinense*) genera plants are usually used as rhizomes and/or roots.

The 5 species (5 genera) used with the stems include *Aegopodium* (*A. alpestre*), *Coriandrum* (*C. sativum*), *Foeniculum* (*F. vulgare*), *Ligusticum* (*L. chuanxiong*), and *Oenanthe* (*O. javanica*); the 9 species (8 genera) used with the leaves include *Aegopodium* (*A. alpestre*), *Anethum* (*A. graveolens*), *Angelica* (*A. morii*), *Anthriscus* (*A. nemorosa* and *A. sylvestris*), *Carum* (*C. carvi*), *Daucus* (*D. carota*), *Foeniculum* (*F. vulgare*), and *Ligusticum* (*L. chuanxiong*); the 17 species (14 genera) used with the fruits include: *Ammi* (*A. majus*), *Carum* (*C. buriaticum* and *C. carvi*), *Cnidium* (*C. monnieri*), *Coriandrum* (*C. sativum*), *Cuminum* (*C. cyminum*), *Cyclorhiza* (*C. peucedanifolia*), *Daucus* (*D. carota* L. and *D. carota* var. *Carota*), *Pimpinella* (*P. anisum*), *Trachyspermum* (*T. ammi*), and *Visnaga* (*V. daucooides*) genera; the single genera used with the seeds is *Ferula* (*F. bungeana*) (Table 1).

## 5. Traditional Uses

As is shown in Table 1, distinct traditional uses of the 228 AMPs were recorded. Based on their clinical agents, a total of 79 traditional uses are enriched, with 40 species contributing to the treatment of relieving pain, 36 species to the treatment of dispelling wind; and 21 species to the treatment of eliminating dampness (Figure 2).

Moreover, the AMPs were also widely used as “ethnodrugs” for ethnic minorities in China. For example, *Carum carvi* was used as Tibetan medicine for the treatment of dispelling wind and eliminating dampness, as well as treating cat fever and joint pain [86]; *Trachyspermum ammi* [236] was used as Uygur medicine for the treatment of eliminating cold damp, dispelling coldness, and promoting digestion; *Angelica acutiloba* was used in Korean medicine for the treatment of strengthening the spleen, enriching blood, stopping bleeding, and promoting coronary circulation [237]; *Angelica sinensis* was used as medicine for the Tujia minority for the treatment of enriching the blood, treating dysmenorrhea, and relaxing the bowel [238]; and *Chuanminshen violaceum* was used as a geo-authentic medicine of Sichuan province for the treatment of moistening the lungs, treating phlegm, and nourishing the spleen and stomach [89].

Meanwhile, AMPs combined with other herbs have also been applied for thousands of years [239]. For example, the Decoction of *Notopterygium* for Rheumatism is a famous Chinese prescription and is composed of *Notopterygium incisum*, *Angelica biserrata*, *Ligusticum sinense*, *Eryngium foetidum*, and *Ligusticum chuanxiong*, etc.; it has been widely used for the treatment of exopathogenic wind-cold, rheumatism, headache, and pantalgia [94]. The Xinyisan that is composed of *Yulania liliiflora*, *Actaea cimicifuga*, *Angelica dahurica*, *Eryngium foetidum*, *Ligusticum sinense*, etc., has been widely used for the treatment of deficiency of pulmonary qi and nasal obstruction due to wind-cold pathogens and damp-heat in the lung channel [94,168]. The Shiquan Dabu Wan of *Angelica sinensis* that is recorded in the “*Pharmacopoeia of the People’s Republic of China*” has been mainly used for the treatment of pallor, fatigability, and palpitations [240]. The Juanbi Tang of *Notopterygium incisum* and *Angelica biserrata* that is recorded in “*Medical Words*” (Qing dynasty) has been mainly used for treatment of arthralgia due to wind cold-dampness [121].

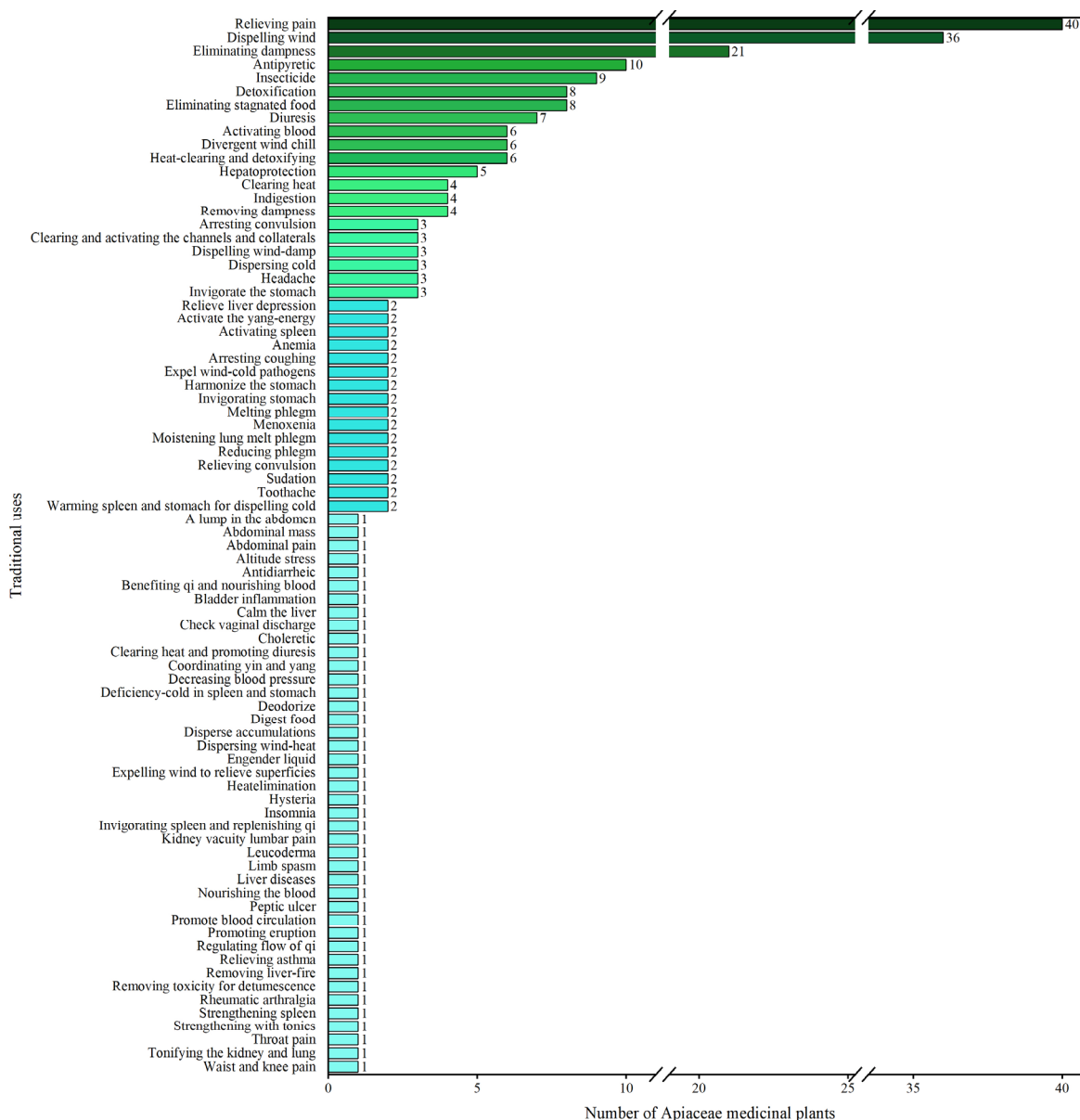
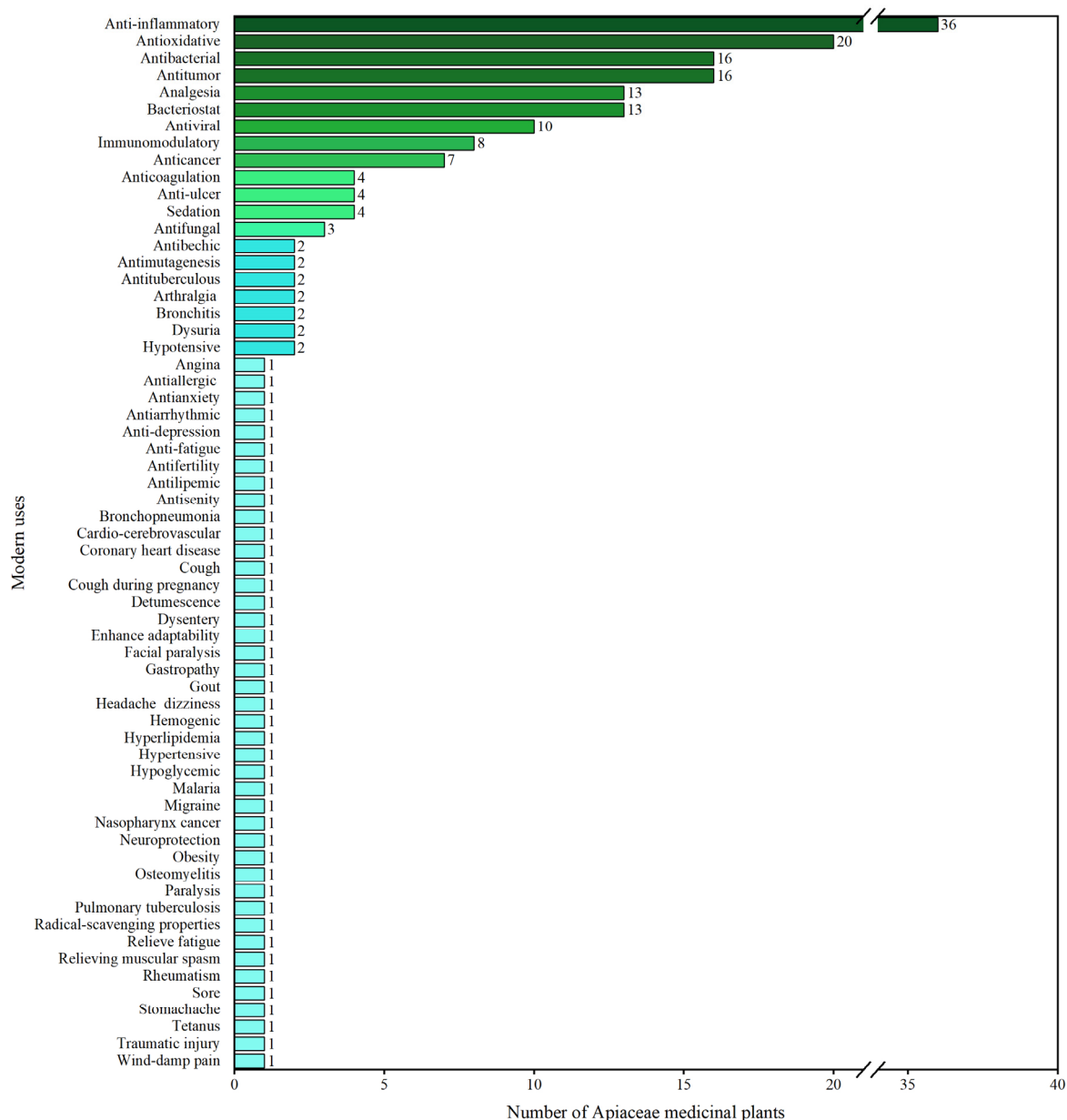


Figure 2. Traditional use of the 228 AMPs.

### 6. Modern Pharmacological Uses

Modern pharmacological research on the 228 AMPs is summarized in Table 1. Based on the pharmacological effects, a total of 62 modern uses are identified (Figure 3), with 36 species showing anti-inflammatory activity, 20 species showing antioxidant activity, and 16 species showing antitumor activity. In addition, other modern uses are also identified, such as antitumor, bacteriostatic, and analgesic. These modern pharmaceutical properties have been demonstrated to be associated with bioactive metabolites, and several metabolites have been found to be co-existent in the TCMs [241,242].





**Figure 3.** Modern pharmacological uses of the 228 AMPs.

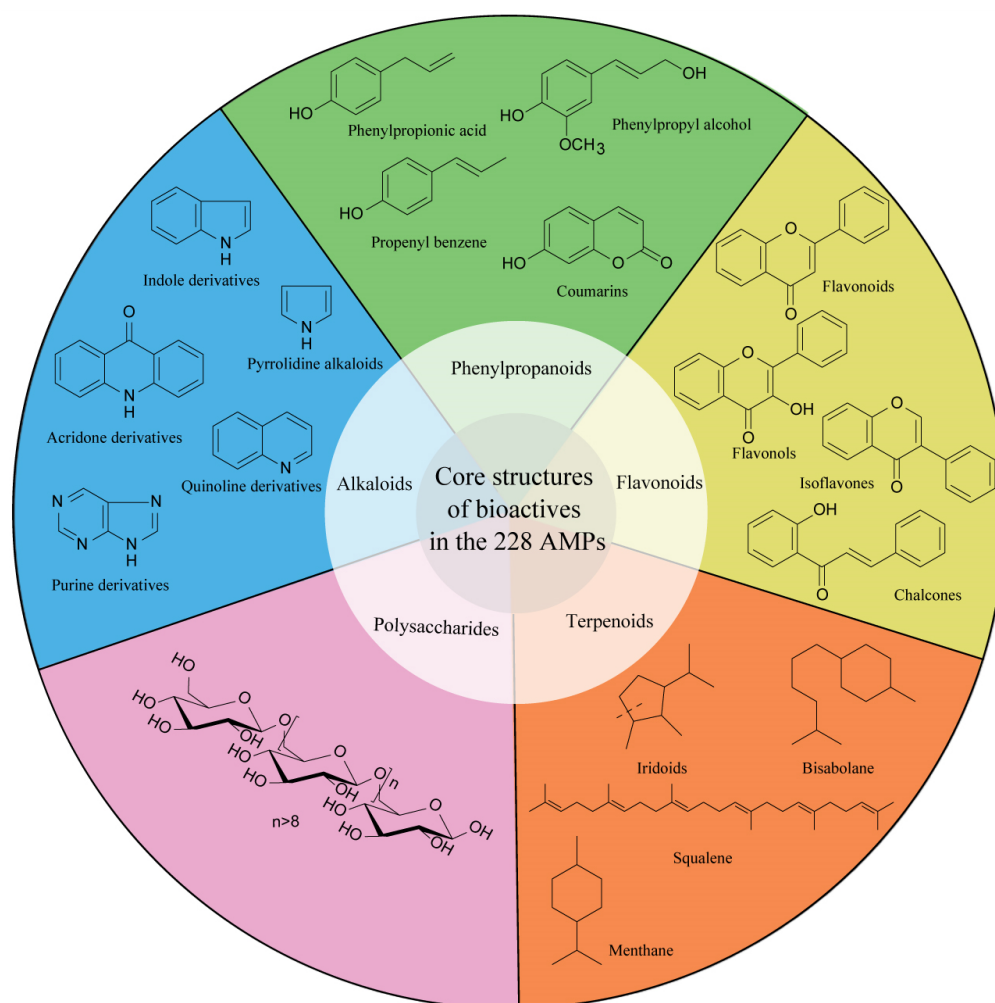
Specifically, sesquiterpene-coumarin, such as (3'S, 5'S, 8'R, 9'S, 10'R)-kellerin, gummolin, galbanic acid, and methyl galbanate from *Ferula sinkiangensis* resin, showed anti-neuroinflammatory effects and might be a potential natural therapeutic agent for Alzheimer's disease [243]. The supercritical carbon dioxide extracts from *Apium graveolens* showed antibacterial effects, with the highest inhibitory activity against *Bacillus cereus* [244,245]. In vitro, the antitumor activity of AMPs have been identified; for example, the ferulin B and C in *Ferula ferulaeoides* rhizomes could restrain the multiplication of HepG2 stomach cancer cell lines, and 2,3-dihydro-7-hydroxyl-2R\*, 3R\*-dimethyl-2-[4,8-dimethyl-3(E),7-nonadienyl]-furo [3,2-c] coumarin could restrain the proliferation of HepG2, MCF-7, and C6 cancer cell lines [107,246]. In addition, the osthole in *Angelica biserrata* could restrain the multiplication of human gastric cancer cell lines MKN-45 and BGC-823, human lung adenocarcinoma cell line A549, human mammary carcinoma cell line MCF-7, and human colon carcinoma cell line LOVO [247]. The antioxidative activity of AMPs has been also identified; for example, the imperatorin, oxypeucedanin hydrate, and bergaptol in *Angelica dahurica* exhibited DPPH scavenging activity [30], hydromethanolic extracts from *Pimpinella*



*anisum* exhibited free radical scavenging activity [248], and water-soluble polysaccharides in *Chuanminshen violaceum* scavenged DPPH, hydroxyl, and superoxide anion radicals [91].

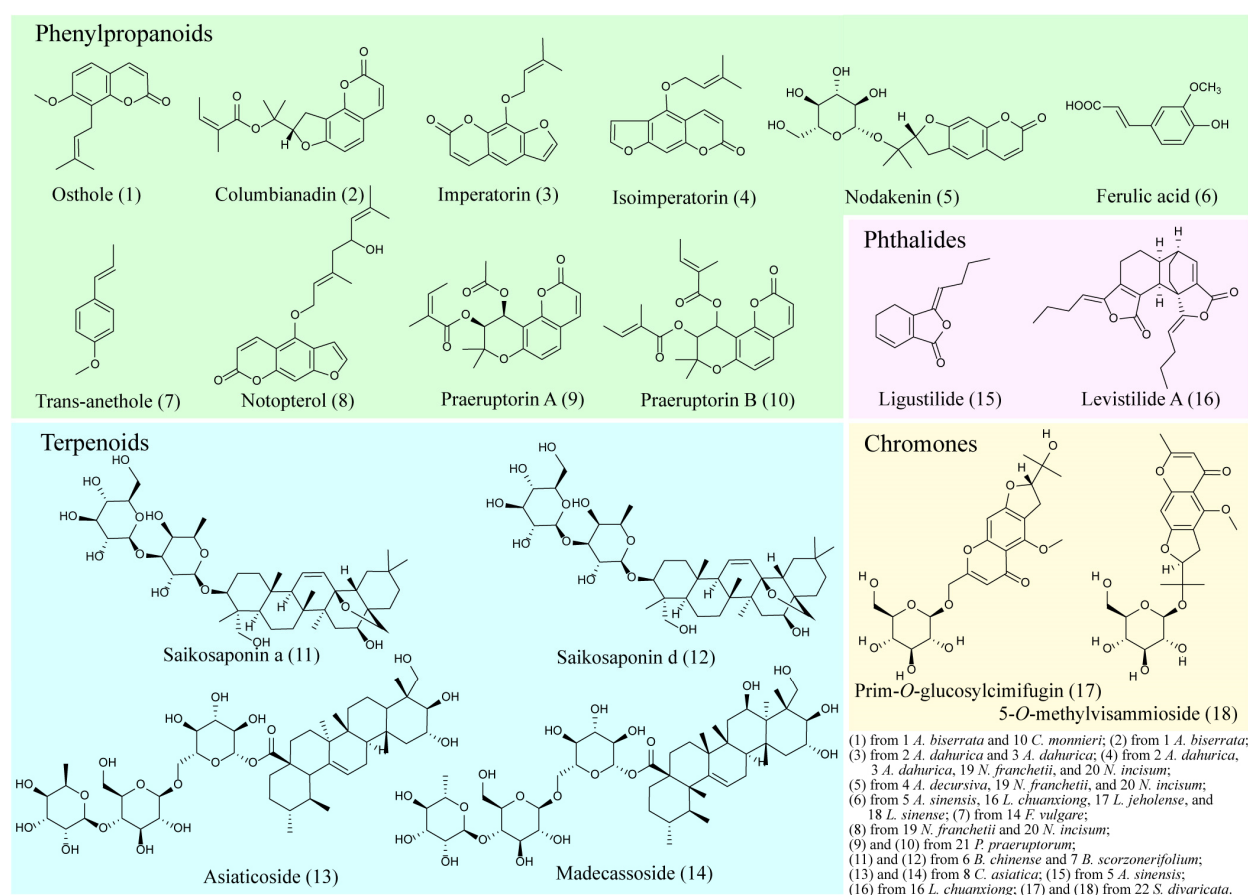
## 7. Phytochemistry

As is shown in Table 1, hundreds of bioactive metabolites have been identified from the 228 AMPs [1,249]. Based on their chemical structures, these metabolites can be categorized into five main classes: (1) polysaccharides, (2) alkaloids, (3) phenylpropanoids, (4) flavonoids, and (5) terpenoids (Figure 4).



**Figure 4.** Core structures of five different bioactive compounds identified from the 228 AMPs.

Among the 22 AMPs recorded in the “*Pharmacopoeia of the People’s Republic of China*” [18], 18 secondary metabolites in the 17 AMPs (e.g., *Angelica biserrata*, *Bupleurum chinense* DC., and *Centella asiatica*) (Figure 5) were described as quality control indicators, which include: 10 phenylpropanoids (i.e., osthole, columbianadin, imperatorin, isoimperatorin, nodakenin, ferulic acid, trans-anethole, notopterol, praeruptorin A, and praeruptorin B), 4 terpenoids (i.e., saikosaponin a, saikosaponin d, asiaticoside, and madecassoside), 2 chromones (i.e., prim-O-glucosylcimifugin and 5-O-methylvisammioside), and 2 phthalides (i.e., ligustilide and levistilide A); a specific quality marker has not been reported for the other 5 AMPs (e.g., *Changium smyrnioides*, *Daucus carota* L., and *Glehnia littoralis*) (Table 2).



**Figure 5.** Structures of the 18 quality markers from the 22 AMPs in the “Pharmacopoeia of the People’s Republic of China” (2020) [18].

### 7.1. Polysaccharides

Polysaccharides are the largest components of biomass and account for ca. 90% of the carbohydrates in plants [250]. Studies have demonstrated that polysaccharides in medicinal plants are indispensable bioactive compounds, presenting uniquely pharmacological effects such as immunomodulatory, hypoglycemic, antitumor, anti-diabetic, and antioxidant effects, amongst others, with few side effects or adverse drug reactions [251,252]. To date, polysaccharides in the 228 AMPs have also been identified, showing multiple pharmacological effects. For example, polysaccharides in *Angelica sinensis* present hematopoietic, antitumor, and liver protection effects [239,253]; polysaccharides in *Angelica dahurica* protect spleen lymphocytes, natural killer cells, and procoagulants [254,255]; and polysaccharides in *Bupleurum chinense* and *Bupleurum smithii* present the effect of macrophage modulation, kidney protection, and inflammatory alleviation [256–258].

### 7.2. Alkaloids

About 27,000 alkaloids presenting as water-soluble salts of organic acids, esters, and combined with tannins or sugars have been found in plants [259]. Many alkaloids are valuable medicinal agents that can be utilized to treat various diseases, including malaria, diabetes, cancer, cardiac dysfunction, blood clotting-related diseases, etc. [260–262]. Alkaloids in the 228 AMPs mainly exist in the *Ligusticum*, *Apium*, *Conium*, and *Cuminum* genera [249]. Pharmacological studies have demonstrated that alkaloids in *Ligusticum chuanxiong* show the activity of inhibiting myocardial fibrosis, protecting ischemic myocardium, and relieving cerebral ischemia-reperfusion injury [151,263,264]. A novel alkaloid 2-pentylpiperidine known as conmaculatin in *Conium maculatum* shows strong peripheral and central antinociceptive activity [265]. Some alkaloids have been identified to show antidepressant activity,

such as berberine in *Berberis aristata*, strictosidine acid in *Psychotria myriantha*, and Anonaine in *Annona cherimolia*; these could be explored as an emerging therapeutic alternative for the treatment of depression.

**Table 2.** Quality markers in the 22 AMPs recorded in the “*Pharmacopoeia of the People’s Republic of China*” (2020) [18].

No./No. in Table 1	Plant Species	Quality Markers	Classification	Biosynthetic Pathway
1/8	<i>Angelica biserrata</i>	Osthole (1) and columbianadin (2)	Coumarins	Phenylpropanoids
2/10	<i>Angelica dahurica</i>	Imperatorin (3) and isoimperatorin (4)	Coumarins	Phenylpropanoids
3/11	<i>Angelica dahurica</i> cv. Hangbaizhi	(3) and (4)	Coumarins	Phenylpropanoids
4/13	<i>Angelica decursiva</i>	Nodakenin (5)	Coumarins	Phenylpropanoids
5/20	<i>Angelica sinensis</i>	Ferulic acid (6) and ligustilide (15)	Propenyl benzenes and phthalides	Phenylpropanoids and phthalides
6/34	<i>Bupleurum chinense</i>	Saikosaponin a (11) and saikosaponin d (12)	Triterpenes	Terpenes
7/67	<i>Bupleurum scorzonerifolium</i>	(11) and (12)	Triterpenes	Terpenes
8/79	<i>Changium asiatica</i>	Asiaticoside (13) and madecassoside (14)	Triterpenes	Terpenes
9/80	<i>Changium smyrnioides</i>	–	–	–
10/83	<i>Changium monnieri</i>	(1)	Coumarins	Phenylpropanoids
11/94	<i>Daucus carota</i>	–	–	–
12/102	<i>Ferula fukanensis</i>	–	–	–
13/109	<i>Ferula sinkiangensis</i>	–	–	–
14/112	<i>Foeniculum vulgare</i>	Trans-anethole (7)	Phenylpropene	Phenylpropanoids
15/113	<i>Glehnia littoralis</i>	–	–	–
16/159	<i>Ligusticum chuanxiong</i>	(6) and levistilide A (16)	Phenylpropanoids and phthalide	Phenylpropanoids and phthalides
17/160	<i>Ligusticum jeholense</i>	(6)	Phenylpropanoids	Phenylpropanoids
18/162	<i>Ligusticum sinense</i>	(6)	Phenylpropanoids	Phenylpropanoids
19/167	<i>Notopterygium franchetii</i>	(4), (5), and notopterol (8)	Coumarins	Phenylpropanoids
20/168	<i>Notopterygium incisum</i>	(4), (5), and (8)	Coumarins	Phenylpropanoids
21/186	<i>Peucedanum praeruptorum</i>	Praeruptorin A (9) and praeruptorin B (10)	Coumarins	Phenylpropanoids
22/213	<i>Saposhnikovia divaricata</i>	Prim-O-glucosylcimifugin (17) and 5-O-methylvisammioside (18)	Chromones	Chromones

Note: “–” indicates there are no specific quality markers recorded in the “*Pharmacopoeia of the People’s Republic of China*” (2020) [18].

### 7.3. Phenylpropanoids

Phenylpropanoids are a large class of secondary metabolites biosynthesized from amino acids, phenylalanine, and tyrosine [266]. Over 8000 aromatic metabolites of the phenylpropanoids have been identified in plants. These include simple phenylpropanoids (propenyl benzene, phenylpropionic acid, and phenylpropyl alcohol), coumarins, lignins, lignans, and flavonoids [267].

#### 7.3.1. Simple Phenylpropanoids

To date, limited simple phenylpropanoids have been identified from AMPs, including three phenylpropanoids (trans-isoelemicin, sarisan, and trans-isomyristicin) in the roots of *Ligusticum mutellina* [268]. Ferulic acid, one of the phenylpropionic acids, is an important bioactive metabolite of AMPs; it mainly exists in *Angelica*, *Ligusticum*, *Ferula*, and *Pleurospermum* genera [239,269,270]. Pharmacological studies have demonstrated that the ferulic acid in *Angelica sinensis* shows strong properties in inhibiting platelet aggregation,

increasing coronary blood flow, and stimulating smooth muscle [271,272]; the ferulic acid in *Angelica acutiloba* shows antidiabetic, immunostimulant, anti-inflammatory, antimicrobial, anti-arrhythmic, and antithrombotic activity [273]; and the ferulic acid in *Ligusticum tenuissimum* shows anti-melanogenic and anti-oxidative effects [274].

### 7.3.2. Coumarins

Coumarins are the most widespread in 20 genera of AMPs (e.g., *Angelica*, *Bupleurum*, and *Peucedanum*) and mainly include simple coumarins, pyranocoumarins, and furocoumarins [56,275,276]. In recent years, distinct coumarins have been identified from AMPs, such as 99 coumarins in *Ferula* [277], 116 coumarins in *Angelica decursiva* and *Peucedanum praeruptorum* [180], and 9 coumarins in *Angelica dahurica* [278]. Furthermore, 8 coumarins were selected as quality markers, including osthole (1) in *Angelica biserrata* and *Cnidium monnieri*; columbianadin (2) in *Angelica biserrata*; imperatorin (3) in *Angelica dahurica* and *Angelica dahurica* cv. Hangbaizhi; isoimperatorin (4) in *Angelica dahurica*, *Angelica dahurica* cv. Hangbaizhi, *Notopterygium franchetii*, and *Notopterygium incisum*; nodakenin (5) in *Angelica decursiva*, *Notopterygium franchetii*, and *Notopterygium incisum*; notoptero (8) in *Notopterygium franchetii* and *Notopterygium incisum*; and praeruptorin A (9) and praeruptorin B (10) in *Peucedanum praeruptorum* (see Table 2 and Figure 5) [18].

To date, various biological activities of coumarins have been demonstrated, including antifungal, antimicrobial, antiviral, anti-cancerous, antitumor, anti-inflammatory, anti-filarial, enzyme inhibitory, antiaflatoxic, analgesic, antioxidant, and oestrogenic [279–282]. For example, coumarins are recognized as the main bioactive constituents in *Peucedani* genus and play critical roles in relieving cough and asthma, strengthening heart function, as well as preventing and treating cardiovascular diseases such as nodakenin, (+)-praeruptorin B, and praeruptorin C [283]; imperatorin oxypeucedanin hydrate, xanthotoxol, bergaptol, 5-methoxy-8-hydroxypsoralen, isoimperatorin, phelloptorin, and pabularinone in *Angelica dahurica* exhibit moderate DPPH scavenging activity, strong ABTS<sup>+</sup> scavenging activity, and significant inhibition on HepG2 cells, which could be explored as new and potential natural antioxidants and cancer prevention agents [30]; pabulenol and osthol extracts from *Angelica genuflexa* show anti-platelet and anti-coagulant components [38]; and decursinol angelate in *Angelica gigas* shows platelet aggregation and blood coagulation activity [38].

### 7.4. Flavonoids

Flavonoids are a group of the most abundant secondary metabolites in plants [266]. Generally, flavonoids can be further categorized into eight subgroups, including flavones (e.g., apigenin, luteolin, and baicalein), flavonols (e.g., kaempferol, quercetin, and myricetin), flavanones (e.g., naringenin, hesperitin, and liquiritigenin), flavanonols (e.g., dihydrokaempferol, dihydromyricetin, and dihydroquercetin), isoflavones (e.g., daidzein, purerarin, and pete-rocarpin), aurones, anthocyanidins, and proanthocyanidins [284–286]. In recent years, flavonoids have been identified from AMPs, such as 6 flavonoids (e.g., luteolin, isoquercitrin, and rutin) in *Ferula* [107], 12 flavonoids (e.g., quercetin-3-O-rutinoside, kaempferol-3,7-di-O-rhamnoside, quercetin-3-O-arabinoside) in *Bupleurum* [287], and 18 flavonoids (e.g., rutin, quercetin, and quercitrin) in *Hydrocotyle* [135].

To date, various biological activities of flavonoids have been demonstrated, including antioxidant, anti-inflammatory, antidiabetic, anticancer, antiobesity, and cardioprotective [284,288]. For example, the apigenin in *Apium graveolens* shows anticancer properties [21], flavonoids in *Pimpinella diversifolia* DC., *Anthriscus sylvestris*, and *Sanicula astantifolia* show antioxidant effects [197,289], and quercetin and its metabolites show vasodilator effects, with selectivity toward the resistance vessels [290].

### 7.5. Terpenoids

About 25,000 terpenoids have been reported in plants; they are diverse secondary metabolites containing three subgroups, including monoterpenoids, sesquiterpenes, and triterpenoids [291]. To date, terpenoids have been also identified in AMPs, such as 4 ter-

penoids (e.g., angelicoidenol, pregnenolone, and  $\beta$ -sitosterol) in *Pleurospermum* [142], 75 terpenoids (e.g., myrcene, farnesene, and xiongterpene) in *Ligusticum* [141], 109 terpenoids (e.g., nerolidol, guaial, and ferulactone A) in *Ferula* [277], and 13 triterpenoids (e.g., ranuncoside, oleanane, and barrigenol) in *Hydrocotyle sibthorpioides* Lam. [136]. Specifically, saikosaponin triterpenes constitute the main class of secondary metabolites in the genus *Bupleurum*, with more than 90 saponins (e.g., saikosaponin a, b, and c) isolated [64,292].

Studies have found that terpenoids possess various biological activities, including anti-inflammatory, anti-oxidative, anti-fibrosis, antitumor, anti-Alzheimer's disease, and anti-depression activities [293,294]. For example, the xiongterpene in *Ligusticum chuanxiong* shows insecticide effects [151], the asiaticoside in *Centella asiatica* shows antitumor properties [295], and the saikosaponin d in *Bupleurum chinense* DC. and *Bupleurum scorzonerifolium* show the effects of reducing blood glucose, inhibiting inflammation, and reducing insulin resistance [296].

#### 7.6. Other Compounds

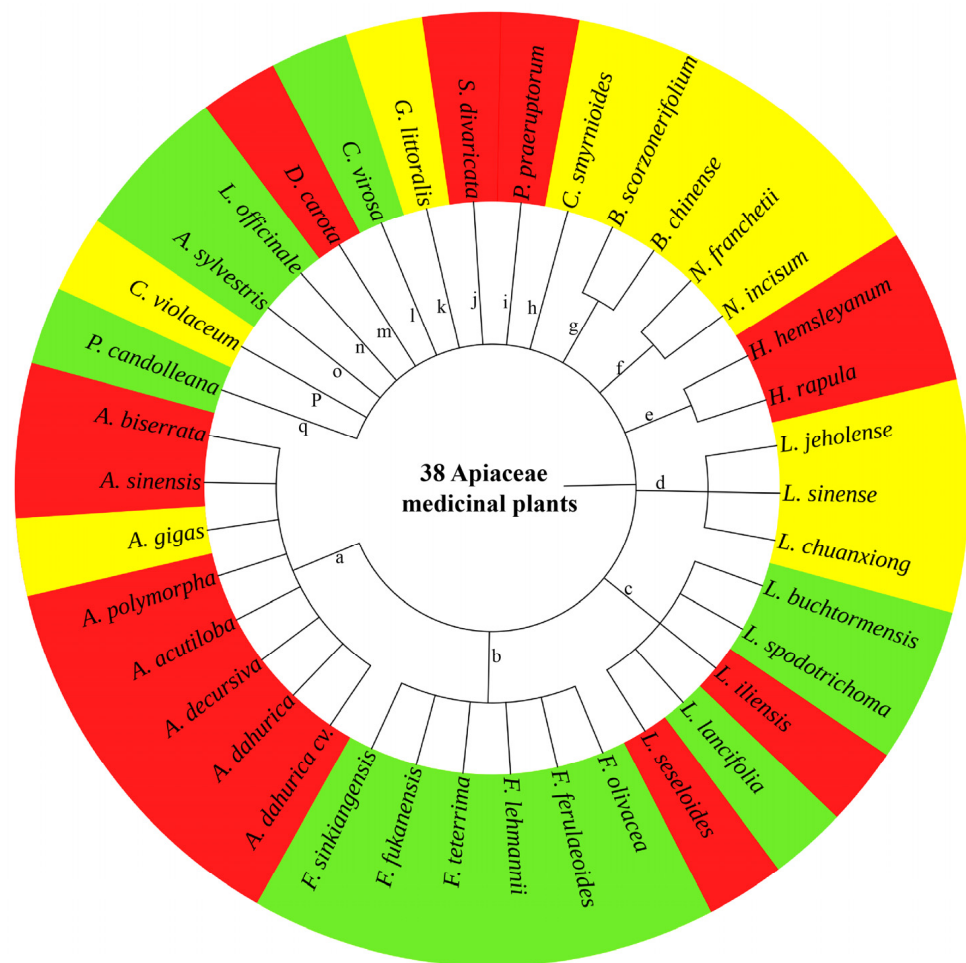
Chromones and phthalides also exist in AMPs and show pharmacological properties. Specifically, phthalides (e.g., ligustilide, *n*-butylidenephthalide, and *Z*-ligustilide) in *Angelica sinensis* show the effect of inhibiting vasodilation, decreasing platelet aggregation, as well as exerting analgesic, anti-inflammatory, and anti-proliferative effects [239]; butylphthalide in *Ligusticum sinense* shows anti-inflammatory and antithrombus effects, dilates blood vessels, and improves brain microcirculation and anti-myocardial ischemia [155].

In terms of chromones, 3 chromones (i.e., 5 hydroxy 2 [(angebyloxy) mehy] fuan chrnone, angelitcin A, and noreugenin) in *Angelica polymorpha* [297], 10 chromones (e.g., cnidimoside A, cnidimol B, and peucenin) in *Cnidiummonnieri* (L.) Cuss. [93], and 22 chromones (e.g., edebouriellol, hamaudol, and 3'(R)-(+)-hamaudol) in *Saposhnikovia divaricate* [218] have been identified. Studies have found that two chromones 3'S(-)-O-acetylhamaudol and ( $\pm$ )-hamaudol in *Angelica morii* show the effect of inhibiting  $Ca^{2+}$  influx of vascular smooth muscle [298], prim-O-glucosylcimifugin and 5-O-methylvisammioside show antipyretic, analgesic, and anti-inflammatory effects [299], and chromones in *Bupleurum multinerve* show analgesic effects [300].

### 8. Effect of Bolting and Flowering (BF) on Yield and Quality

Previous studies have repeatedly emphasized that BF reduces the yield and quality of plants, especially in rhizomatous medicinal plants [11]. Here, a total of 38 rhizomatous plants that have been reported in the 228 AMPs are associated with BF (Table 3). Based on the effect degree of BF on the yield and quality, 38 rhizomatous AMPs belonging to 17 genera can be categorized into 3 classes: (1) BF significantly affects the yield and quality of 14 AMPs (i.e., *Angelica acutiloba*, *Angelica biserrata*, *Angelica dahurica*, *Angelica dahurica* cv. Hangbaizhi, *Angelica decursiva*, *Angelica polymorpha*, *Angelica sinensis*, *Daucus carota*, *Heracleum hemsleyanum*, *Heracleum rapula*, *Libanotis iliensis*, *Libanotis seseloides*, *Peucedanum praeruptorum*, and *Saposhnikovia divaricata*), and their rhizomes and/or roots are wholly lignified and cannot be used for clinical application; (2) BF affects the yield of 11 AMPs (i.e., *Angelica gigas*, *Bupleurum chinense*, *Bupleurum scorzonerifolium*, *Changium smyrnioides*, *Chuanminshen violaceum*, *Glehnia littoralis*, *Ligusticum chuanxiong*, *Ligusticum jeholense*, *Ligusticum sinense*, *Notopterygium franchetii*, and *Notopterygium incisum*), though their rhizomes or roots can be used as medicine to some extent; (3) BF has no significant effect on the yield and quality of 13 AMPs (i.e., *Angelica sylvestris*, *Cicuta virosa*, *Ferula ferulaeoides*, *Ferula fukanensis*, *Ferula lehmannii*, *Ferula olivacea*, *Ferula sinkiangensis*, *Ferula teterrima*, *Levisticum officinale*, *Libanotis buchtormensis*, *Libanotis lancifolia*, *Libanotis spodotrichoma*, and *Pimpinella candolleana*), and their rhizomes or roots can be used as medicine (Figure 6).





**Figure 6.** Cluster of the 38 rhizomatous AMPs affected by bolting and flowering (BF). The red color indicates that BF significantly affects the yield and quality; the yellow color indicates that BF affects the yield, though the rhizomes or roots can be used as medicine to some extent; and the green color indicates that BF has no significant effect on the yield and quality. a: *Angelica*, b: *Ferula*, c: *Libanotis*, d: *Ligusticum*, e: *Heracleum*, f: *Notopterygium*, g: *Bupleurum*, h: *Changium*, i: *Peucedanum*, j: *Saposhnikovia*, k: *Glehnia*, l: *Cicuta*, m: *Daucus*, n: *Levisticum*, o: *Anthriscus*, p: *Chuanminshen*, and q: *Pimpinella*.

For example, for class (1) after BF, there was a 8.3- and 16.1-fold reduction of dry weight and quality marker ferulic acid content in *Angelica sinensis* [301] and a 1.5- and 1.5-fold reduction of dry weight and quality marker isoimperatorin content in *Angelica dahurica* [302]. For class (2), there was a 1.34-fold reduction of saikosaponinsands, while no significant change of dry weight in *Bupleurum chinense* was seen [303,304]; and a 2.0- and 1.7-fold reduction of dry weigh and polysaccharide content in *Changium smyrnioides* [305]. For class (3), there was no reduction of the yield and quality of the 13 AMPs at the harvest stages [19].

**Table 3.** Classification of the 38 rhizomatous AMPs affected by BF.

No./No. in Table 1	Plant Species	Classes	References	No./No. in Table 1	Plant Species	Classes	References
1/4	<i>Angelica acutiloba</i> (Siebold & Zucc.) Kitag.	(1)	[306]	20/109	* <i>Ferula sinkiangensis</i> K. M. Shen	(3)	[19]
2/8	** <i>Angelica biserrata</i> (R. H. Shan & C. C. Yuan) C. C. Yuan & R. H. Shan	(1)	[307]	21/111	<i>Ferula teterrima</i> Kar. & Kir.	(3)	[19]
3/10	** <i>Angelica dahurica</i> (Fisch. ex Hoffm.) Benth. & Hook. f. ex Franch. & Sav.	(1)	[308]	22/113	** <i>Glehnia littoralis</i> F. Schmidt ex Miq.	(2)	[309]
4/11	** <i>Angelica dahurica</i> cv. <i>Hangbaizhi</i>	(1)	[308]	23/121	<i>Heracleum hemsleyanum</i> Diels	(1)	[307]
5/13	** <i>Angelica decursiva</i> (Miq.) Franch. & Sav.	(1)	[310]	24/126	<i>Heracleum rapula</i> Franch.	(1)	[19]
6/14	<i>Angelica gigas</i> Nakai	(2)	[311]	25/148	<i>Levisticum officinale</i> W. D. J. Koch	(3)	[19]
7/19	<i>Angelica polymorpha</i> Maxim.	(1)	[19]	26/149	<i>Libanotis buchtormensis</i> (Fisch.) DC	(3)	[312]
8/20	** <i>Angelica sinensis</i> (Oliv.) Diels	(1)	[313]	27/150	<i>Libanotis iliensis</i> (Lipsky) Korovin	(1)	[19]
9/26	<i>Anthriscus sylvestris</i> (L.) Hoffm.	(3)	[314]	28/151	<i>Libanotis lancifolia</i> K. T. Fu	(3)	[19,312]
10/34	** <i>Bupleurum chinense</i> DC.	(2)	[315]	29/153	<i>Libanotis seseloides</i> (Fisch. & C. A. Mey. ex Turcz.) Turcz.	(1)	[19]
11/67	** <i>Bupleurum scorzonerifolium</i> Willd.	(2)	[315]	30/155	<i>Libanotis spodotrichoma</i> K. T. Fu	(3)	[19,312]
12/80	** <i>Changium smyrnioides</i> H. Wolff	(2)	[316]	31/159	** <i>Ligusticum chuanxiong</i> Hort.	(2)	[317]
13/81	<i>Chuanminshen violaceum</i> M. L. Sheh & R. H. Shan	(2)	[318]	32/160	** <i>Ligusticum jeholense</i> Nakai et Kitag.	(2)	[319]
14/82	<i>Cicuta virosa</i> L.	(3)	[19]	33/162	** <i>Ligusticum sinense</i> Oliv.	(2)	[319]
15/96	<i>Daucus carota</i> var. <i>sativus</i> Hoffm.	(1)	[320]	34/167	** <i>Notopterygium franchetii</i> H. de Boiss.	(2)	[321]
16/102	<i>Ferula feruloides</i> (Steud.) Korovin	(3)	[19]	35/168	** <i>Notopterygium incisum</i> Ting ex H. T. Chang	(2)	[321]
17/103	<i>Ferula fukanensis</i> K. M. Shen	(3)	[19]	36/186	** <i>Peucedanum praeruptorum</i> Dunn	(1)	[322]
18/106	<i>Ferula lehmannii</i> Boiss.	(3)	[19]	37/195	<i>Pimpinella candolleana</i> Wight & Arn.	(3)	[19]
19/108	<i>Ferula olivacea</i> (Diels) H. Wolff ex Hand.-Mazz.	(3)	[19]	38/213	** <i>Saposhnikovia divaricata</i> (Turcz.) Schischk.	(1)	[323,324]

Note: (1) BF significantly affects the yield and quality, and the rhizomes or roots cannot be used for clinical applications; (2) BF differently affects the yield, but the rhizomes or roots can be used as medicine to some extent; and (3) BF has no significant effect on the yield and quality, and their rhizomes or roots are used as medicine. \* means the plant reported in “*Pharmacopoeia of the People’s Republic of China (2020)*”, \*\* means the plant roots used as medicine reported in “*Pharmacopoeia of the People’s Republic of China (2020)*” [18].

## 9. Approaches to Control BF

Generally, most Apiaceae plants are “low-temperature and long-day” perennial herbs; in other words, the plants must experience vernalization (i.e., an extended period of cool weather at 0 to 10 °C) and long days (>12 h daylight) to induce BF. Examples include *Angelica sinensis* [325], *Daucus carota* [326], and *Coriandrum sativum* [327].

Table 4 shows the approaches to inhibit BF of 24 AMPs. For example, the bolting rate of *Angelica sinensis* can be significantly decreased by planting the green stem cultivar (Mingui 2) instead of the purple stem cultivar (Mingui 1) [328], selecting smaller seedlings (i.e., root-shoulder diameter <0.55 cm) instead of larger seedlings [329,330], storing the seedlings at freezing temperature (i.e., <0 °C) during the overwinter stage [325], shading the plants



under sunshade (i.e., >40%) during growth stage [331], and providing the plants with good growth conditions (e.g., plant intensity, nutrient and water balance) [332]. The bolting rate of *Angelica dahurica* can be significantly decreased through planting pure breeds [333], selecting immature seeds for seeding [308], increasing potassic fertilizer while decreasing nitrogen and phosphorus fertilizers [334], and planting using standard techniques [335]. The bolting rate of *Saposhnikovia divaricata* can also be significantly decreased by controlling the sunshade [336], sowing date [337], and planting density [338], and preventing excessive growth [336].

**Table 4.** Reported approaches for inhibiting BF in 25 AMPs.

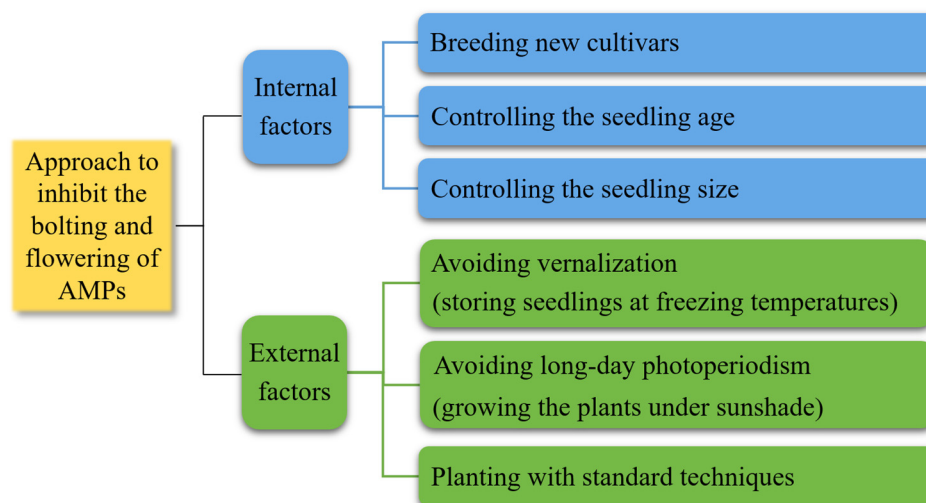
Class	No./No. in Table 1	Plant Species	Measure I (Seeding)	Measure II (Cultivation)	Measure III (Abiotic)	Measure IV (Molecular Biology)
(1)	1/4	<i>Angelica acutiloba</i> (Siebold & Zucc.) Kitag.	Seedling diameter [339]	Density of planted seedlings [339]	Paclubutrazol concentration [339]	\
(1)	2/8	** <i>Angelica biserrate</i> (R. H. Shan & C. C. Yuan) C. C. Yuan & R. H. Shan	Seedling size and root length [307]	\	\	\
(1)	3/10	** <i>Angelica dahurica</i> (Fisch. ex Hoffm.) Benth. & Hook. f. ex Franch. & Sav.	Seed quality and seed maturity degree [308,333]	Soil selection to avoid continuous cropping and fertile sticky soil, density of planted seedlings, and seeding time [333,335,340]	Rational application of fertilizer, and appropriate N, P, and K fertilizer [308,333,341]	Seven types of reproductive conversion genes, and constans-like genes [342,343]
(1)	4/11	** <i>Angelica dahurica</i> cv. Hangbaizhi	Seed quality and seed maturity degree [308,333]	Soil selection to avoid continuous cropping and fertile sticky soil, density of planted seedlings, and seeding time [333,335,340]	Rational application of fertilizer, and appropriate N, P, and K fertilizer [308,333,341]	Seven types of reproductive conversion genes, and constans-like genes [342,343]
(1)	5/13	** <i>Angelica decursiva</i> (Miq.) Franch. & Sav.	\	\	\	\
(1)	6/19	<i>Angelica polymorpha</i> Maxim.	\	\	\	\
(1)	7/20	** <i>Angelica sinensis</i> (Oliv.) Diels	Seed maturity degree, seeding age, seeding weight, root diameter, and excellent variety [328,330,344–346]	Short day, storage temperature, and reasonable planting and cultivation [313,344,347]	Plant growth retardant [348]	Four pathways of genes for regulating early BF [349,350]
(1)	8/96	<i>Daucus carota</i> var. <i>Sativus</i> Hoffm.	Endogenous hormone content and different cultivars [351,352]	Temperature, short day, and seeding time [351,353–355]	\	Two major genes: <i>Bol1-1</i> and <i>Bol1-2</i> [356]
(1)	9/121	<i>Heracleum hemsleyanum</i> Diels	\	\	\	\
(1)	10/126	<i>Heracleum rapula</i> Franch.	\	\	\	\
(1)	11/150	<i>Libanotis iliensis</i> (Lipsky) Korovin	\	\	\	\
(1)	12/153	<i>Libanotis seseloides</i> (Fisch. & C. A. Mey. ex Turcz.) Turcz.	\	\	\	\
(1)	13/186	** <i>Peucedanum praeruptorum</i> Dunn	\	Compact planting and seeding time [357,358]	\	\

Table 4. Cont.

Class	No./No. in Table 1	Plant Species	Measure I (Seeding)	Measure II (Cultivation)	Measure III (Abiotic)	Measure IV (Molecular Biology)
(1)	14/213	** <i>Saposhnikovia divaricata</i> (Turcz.) Schischk.	\	Density of planted seedlings [338]	\	Differentially expressed genes associated with BF during early flowering, flower bud differentiation, and late flowering [359]
(2)	15/14	<i>Angelica gigas</i> Nakai	\	\	\	\
(2)	16/34	** <i>Bupleurum chinense</i> DC.	\	Cut the flowers [315]	Temperature [360]	Flowering gene (BcSVP, BcPAF1, BcCO, and BcFT) [361]
(2)	17/67	** <i>Bupleurum scorzonerifolium</i> Willd.	\	\	\	\
(2)	18/80	<i>Changium smyrnioides</i> H. Wolff	\	Cut the flowers [316]	\	\
(2)	19/81	<i>Chuanminshen violaceum</i> M. L. Sheh & R. H. Shan	\	\	\	\
(2)	20/113	** <i>Glehnia littoralis</i> F. Schmidt ex Miq.	\	Cut the flowers [309]	\	\
(2)	21/159	** <i>Ligusticum chuanxiong</i> Hort.	Asexual reproduction and tissue culture [317,362]	Cut the bolted stem [363]	\	Transcriptome original data by Illumina sequencing technology [364]
(2)	22/160	** <i>Ligusticum jeholense</i> Nakai et Kitag.	\	Cut the flower [365,366]	\	\
(2)	23/162	** <i>Ligusticum sinense</i> Oliv.	\	Cut the flower [365,366]	\	\
(2)	24/167	** <i>Notopterygium franchetii</i> H. de Boiss.	\	Cut the flower [367]	\	\
(2)	25/168	** <i>Notopterygium incisum</i> Ting ex H. T. Chang	\	Cut the flower [321]	\	\

Note: \*\* means the plant roots used as medicine reported in “Pharmacopoeia of the People’s Republic of China (2020)” [18].

To inhibit the occurrence of BF in AMPs, several measures can be used, including breeding new cultivars, controlling the seedling age and size to delay the transition from vegetative growth to flowering, storing seedlings at freezing temperatures to avoid vernalization, growing the plants under sunshade to avoid long-day photoperiodism, and planting with standard techniques to reduce pests and diseases (Figure 7).

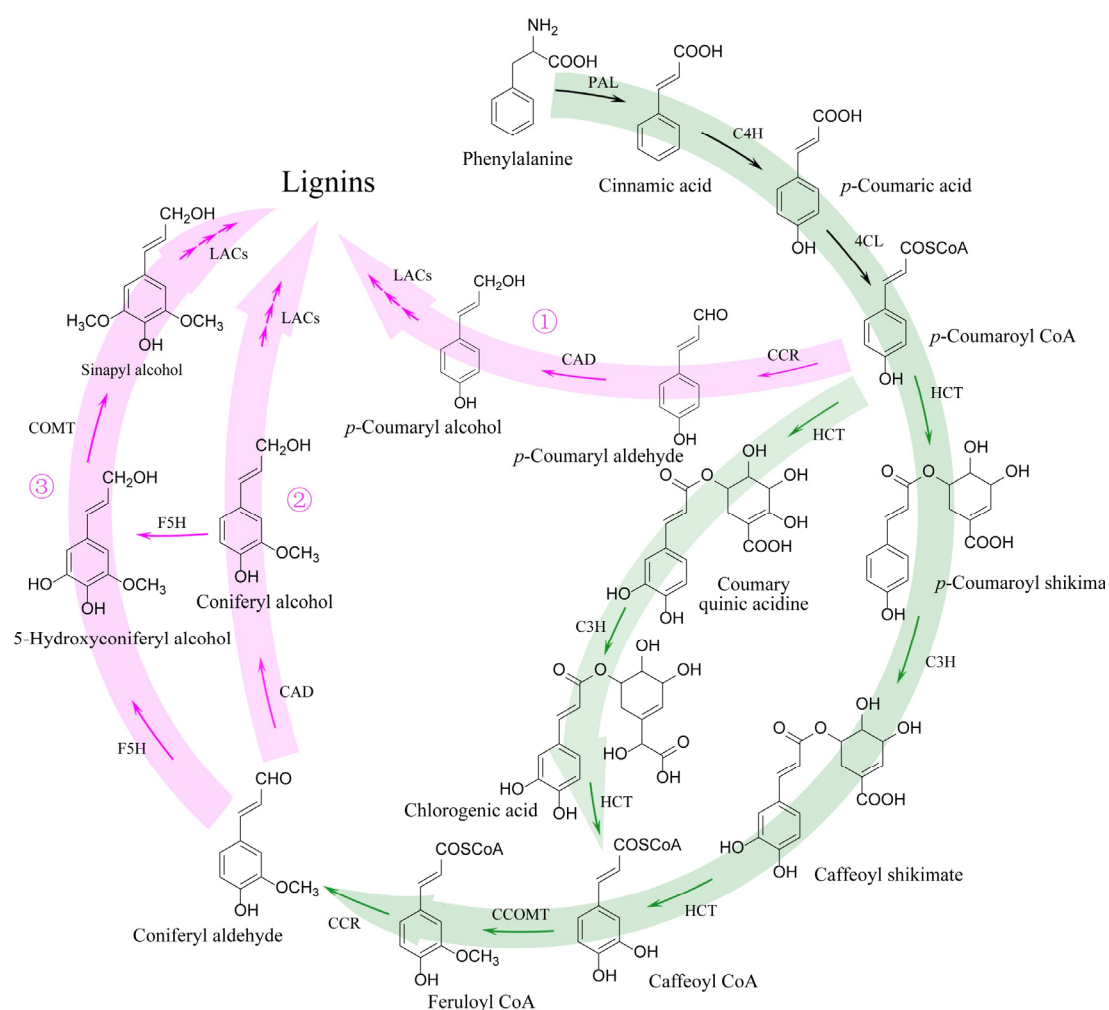


**Figure 7.** Approaches to control the BF of AMPs.

### 10. The Mechanism of BF Inducing the Rhizome Lignification

Extensive experiments have demonstrated that BF induces the lignification of fleshy rhizomes and enhances the degradation of metabolites [11,13,328]. Studies on anatomical structures reveal that the ratio of secondary phloem to secondary xylem respectively changes from 2:1 to 1:10 and 2/5–1/2 to 1/2–3/4 for the rhizomes of *Angelica sinensis* and *Angelica dahurica* before and after BF; meanwhile, the number of secretory cells producing essential oils significantly decreased [368,369]. Studies have found that the Early Bolting In Short Day (EBS) acts as a negative transcriptional regulator, preventing premature flowering of *Arabidopsis thaliana*, and co-enrichment of a subset of EBS-associated genes with H3K4me3, H3K27me3, and Polycomb repressor complex 2 has been observed [370]; a potential genetic resource for radish late-bolting breeding with introgression of the RsVRN1In-536 insertion allele into the early-bolting genotype could contribute to delayed bolting time of *Raphanus sativus* [371]; and *peroxidases* (PRXs) involved in lignin monomer biosynthesis were found to be down-regulated in *Peucedanum praeruptorum* at the bolting stage [372].

As is known, lignin biosynthesis belongs to the general phenylpropanoid pathway, which starts from phenylalanine and is catalyzed by a series of enzymes [13,373]. Specifically, phenylalanine is catalyzed to form *p*-Coumaroyl CoA sequentially through the three enzymes phenylalanine ammonia lyase (PAL), cinnamate 4-hydroxylase (C4H), and *p*-4-coumarate-CoA ligase (4CL). Lignin biosynthesis is synthesized via three sub-pathways, including the following: (1) lignins are catalyzed to from *p*-Coumaroyl CoA sequentially through the three enzymes cinnamoyl-CoA reductases (CCR), cinnamyl alcohol dehydrogenases (CAD), and laccases (LACs), and then coniferyl aldehyde is catalyzed to from *p*-Coumaroyl CoA sequentially through the four enzymes hydroxycinnamoyl shikimate/quinic acid transferase (HCT), *p*-coumarate 3-hydroxylase (C3H), caffeoyl-CoA 3-*O*-methyltransferase (CCOMT), and CCR; (2) lignins are catalyzed to from coniferyl aldehyde sequentially through the two enzymes CAD and LAC; (3) lignins are catalyzed to from coniferyl aldehyde sequentially through the three enzymes ferulate 5-hydroxylase (F5H), caffeic acid 3-*O*-methyltransferase (COMT), and LACs (Figure 8).



**Figure 8.** Schematic representation of biosynthetic pathways of lignins. Abbreviations: PAL, phenylalanine ammonia lyase; C4H, cinnamate 4-hydroxylase; 4CL, 4-coumarate-CoA ligase; HCT, hydroxycinnamoyl shikimate/quinic acid transferase; C3H, *p*-coumarate 3-hydroxylase; CCOMT, caffeoyl-CoA 3-*O*-methyltransferase; CCR, cinnamoyl-CoA reductases; CADs, cinnamyl alcohol dehydrogenases; LACs, laccases; F5H, ferulate 5-hydroxylase; COMT, caffeic acid 3-*O*-methyltransferase. The green color indicates the common phenylpropanoid pathway of phenylpropanoids, and the red color indicates the lignin biosynthetic sub-pathway. The ①, ② and ③ means different sub-pathways of lignin biosynthesis.

Although lignin biosynthesis has been depicted, studies on the mechanism of BF inducing rhizome lignification are still limited. To date, the mechanism of BF affecting *Angelica sinensis* has been revealed, with the expression level of genes (e.g., *PAL1*, *4CLs*, *HCT*, *CAD1*, and *LACs*) significantly upregulated at the stem-node forming and elongating stage compared with the stem-node pre-differentiation stage, leading to the reduction of accumulation of secondary metabolites (i.e., ferulic acid and flavonoids) [13].

## 11. Conclusions and Future Aspects

In this review, we summarized the history of AMPs as TCMs, the classification of AMPs species, their traditional use, modern pharmacological use, and phytochemistry; the effect of BF on yield and quality, approaches to control BF, and the mechanisms of BF, inducing rhizome lignification. Although ca. 228 AMPs, 79 traditional uses, 62 modern uses, and 5 main kinds of metabolites have been recorded, the potential properties remain to be exploited. Although BF significantly reduces the yield and quality of AMPs, effective measures to inhibit BF have not been applied in the field, and the mechanisms of BF have

not been systemically revealed for most AMPs. Thus, in order to effectively control the BF of AMPs to improve their quality and yield, on the one hand, standard cultivation techniques of AMPs should be applied; on the other hand, new cultivars should be developed by modern biotechnology such as the CRISPR/Cas9 system.

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## References

1. Wei, J.; Gao, Y.Z.; Zhou, J.; Liu, Z.W. Collection and sorting of medicinal plants in Chinese Apiaceae (Umbelliferae). *China J. Chin. Mater. Med.* **2019**, *44*, 5329–5335.
2. Yuan, C.Q. Ethnobotanical research on Umbelliferous plants in China. *Chin. J. Ethnomed. Ethnoph.* **1999**, *4*, 221–224+248.
3. Zhao, Z.L.; Yan, Y.P. *Pharmaceutical Botany*, 2nd ed.; Scientific & Technical Publishers: Shanghai, China, 2020.
4. Cai, S.Q. *Pharmacognosics*; People's Medical Publishing House: Beijing, China, 2011.
5. Li, B.; Zhang, W.H.; Gong, H.D. Researches on forage plant resources of Umbelliferae in Gansu. *J. Mudanjiang Norm. Univ.* **2022**, *2*, 57–61.
6. Liu, Y.; Liu, M.; Liu, M.Y. Resource plants of Apiaceae (Umbelliferae) in China. *Terr. Nat. Res. Study* **2002**, *4*, 76–78.
7. Kitashiba, H.; Yokoi, S. Genes for Bolting and Flowering. In *The Radish Genome*; Nishio, T., Kitashiba, H., Eds.; Springer International Publishing: Cham, Switzerland, 2017; pp. 151–163.
8. Mutasa-Göttgens, E.S.; Qi, A.; Zhang, W.; Schulze-Buxloh, G.; Jennings, A.; Hohmann, U.; Müller, A.E.; Hedden, P. Bolting and flowering control in sugar beet: Relationships and effects of gibberellin, the bolting gene *B* and vernalization. *AoB Plants* **2010**, *2010*, plq012. [[CrossRef](#)] [[PubMed](#)]
9. Ning, K.; Han, Y.Y.; Chen, Z.J.; Luo, C.; Wang, S.L.; Zhang, W.J.; Li, L.; Zhang, X.L.; Fan, S.X.; Wang, Q. Genome-wide analysis of MADS-box family genes during flower development in lettuce. *Plant Cell Environ.* **2019**, *42*, 1868–1881. [[CrossRef](#)] [[PubMed](#)]
10. Wen, F.Y.; Zhang, B.; Liu, X.H.; Zhao, B.; Song, L.J.; Luo, Z.M. Research on bolting character and its genetic of *Chinese cabbage*. *Acta Agric. Bor. Sin.* **2006**, *21*, 68–71.
11. Zhao, D.Y.; Hao, Q.X.; Kang, L.P.; Zhang, Y.; Chen, M.L.; Wnag, T.L.; Guo, L.P. Advance in studying early bolting of Umbelliferae medicinal plant. *China J. Chin. Mater. Med.* **2016**, *41*, 20–23.
12. Lincoln, T.; Eduardo, Z. *Plant Physiology*, 5th ed.; Sinauer Associates: New York, NY, USA, 2010.
13. Li, M.L.; Cui, X.W.; Jin, L.; Li, M.F.; Wei, J.H. Bolting reduces ferulic acid and flavonoid biosynthesis and induces root lignification in *Angelica sinensis*. *Plant Physiol. Biochem.* **2022**, *170*, 171–179. [[CrossRef](#)]
14. Shang, Z.J. *Collation and Annotation of Sheng Nong's Herbal Classic*; Academy Press: Beijing, China, 2008.
15. Li, S.Z. *Compendium of Materia Medica*; China Yanshi Publishing House: Beijing, China, 2012.
16. Flora of China. *Flora of China*; Science Press: Beijing, China, 2002.
17. Wang, G.Q. *The Compilation of National Chinese Herbal Medicine*; People's Medical Publishing House: Beijing, China, 2014.
18. Pharmacopoeia of the People's Republic of China. *Pharmacopoeia of the People's Republic of China*; China Medical Science Press: Beijing, China, 2020.
19. Nanjing University of Chinese Medicine. *Dictionary of Chinese Medicine*; Shanghai Scientific & Technical Publishers: Shanghai, China, 2006.
20. Sun, G.R.; Xu, P.; Chang, K. GC/MS analysis of volatile components from *Aegopodiumalpestre* Seeds. *J. Anhui Agric. Sci.* **2009**, *37*, 18–19.
21. Zhou, H.; Lu, X.Y.; Tian, Y.; Huang, C.J. Advances in studies on chemical constituents and pharmacological activities of *Apium* L. *Amino Acids Biot. Resour.* **2006**, *28*, 6–9.
22. Chahal, K.K.; Kumar, A.; Bhardwaj, U.; Kaur, R. Chemistry and biological activities of *Anethum graveolens* L. essential oil: A review. *J. Pharm. Phytochem.* **2017**, *6*, 295–306.



23. Park, M.A.; Sim, M.J.; Kim, Y.C. Anti-photoaging effects of *Angelica acutiloba* root ethanol extract in Human dermal fibroblasts. *Toxicol. Res.* **2017**, *33*, 125–134. [[CrossRef](#)] [[PubMed](#)]
24. Yan, Z.K.; Niu, Z.D.; Pan, N.; Xu, G.J.; Yang, X.W. Analysis of essential oils in roots and fruits of *Angelica* in Northeast China. *China J. Chin. Mater. Med.* **1990**, *15*, 35–37.
25. Sui, C.X. Study on chemical composition of *Angelica serrata*. *Heilongjiang Med. J.* **2010**, *23*, 263.
26. Wu, Z.Y. *Essentials of China Materia Medica (I)*; Shanghai Scientific & Technical Publishers: Shanghai, China, 1988.
27. Zhou, L.L.; Zeng, J.G. Research advances on chemical constituents and pharmacological effects of *Angelica pubescens*. *Mod. Chin. Med.* **2019**, *21*, 1739–1748.
28. Meng, H.L.; Wen, G.S.; Yang, S.C. Research progress of the medicinal plant *Heracleum apaensis*. *Res. Prac. Chin. Med.* **2008**, *22*, 62–65.
29. Liu, M.; Hu, X.; Wang, X.; Zhang, J.J.; Peng, X.B.; Hu, Z.G.; Liu, Y.F. Constructing a core collection of the medicinal plant *Angelica biserrata* using genetic and metabolic data. *Front. Plant Sci.* **2020**, *11*, 600249. [[CrossRef](#)]
30. Bai, Y.; Li, D.H.; Zhou, T.T.; Qin, N.B.; Li, Z.L.; Yu, Z.G.; Hua, H.M. Coumarins from the roots of *Angelica dahurica* with antioxidant and antiproliferative activities. *J. Funct. Foods* **2016**, *20*, 453–462. [[CrossRef](#)]
31. Choi, I.H.; Lim, H.H.; Song, Y.K.; Lee, J.W.; Kim, Y.S.; Ko, I.G.; Kim, K.J.; Kim, C.J. Analgesic and anti-inflammatory effect of the aqueous extract of root of *Angelica Dahurica*. *Orient. Pharm. Exp. Med.* **2008**, *7*, 527–533. [[CrossRef](#)]
32. Lechner, D.; Stavri, M.; Oluwatuyi, M.; Pereda-Miranda, R.; Gibbons, S. The anti-staphylococcal activity of *Angelica dahurica* (Bai Zhi). *Phytochemistry* **2004**, *65*, 331–335. [[CrossRef](#)] [[PubMed](#)]
33. Saiki, Y.; Morinaga, K.; Okegawa, O.; Sakai, S.; Amaya, Y.; Ueno, A.; Fukushima, S. On the coumarins of the roots of *Angelica dahurica* Benth. et Hook. *Yakugaku Zasshi* **1971**, *91*, 1313–1317. [[CrossRef](#)] [[PubMed](#)]
34. Wei, W.; Wu, X.W.; Deng, G.G.; Yang, X.W. Anti-inflammatory coumarins with short- and long-chain hydrophobic groups from roots of *Angelica dahurica* cv. Hangbaizhi. *Phytochemistry* **2016**, *123*, 58–68. [[CrossRef](#)] [[PubMed](#)]
35. Wei, W.; Yang, X.W.; Zhou, Y.Y. Chemical constituents from n-Butanol soluble parts of roots of *Angelica dahurica* cv. Hangbaizhi. *Mod. Chin. Med.* **2017**, *19*, 630–634.
36. Zhao, D.; Islam, M.N.; Ahn, B.R.; Jung, H.A.; Kim, B.W.; Choi, J.S. In vitro antioxidant and anti-inflammatory activities of *Angelica decursiva*. *J. Ophthalmic Nurs. Technol.* **2012**, *35*, 179–192. [[CrossRef](#)]
37. Ahn, M.J.; Lee, M.K.; Kim, Y.C.; Sung, S.H. The simultaneous determination of coumarins in *Angelica gigas* root by high performance liquid chromatography-diode array detector coupled with electrospray ionization/mass spectrometry. *J. Pharm. Biomed. Anal.* **2008**, *46*, 258–266. [[CrossRef](#)]
38. Lee, Y.Y.; Lee, S.; Jin, J.L.; Yun-Choi, H.S. Platelet anti-aggregatory effects of coumarins from the roots of *Angelica genuflexa* and *A. gigas*. *Arch. Pharm. Res.* **2013**, *26*, 723–726. [[CrossRef](#)]
39. Gu, X.Y.; Zhang, H.Q.; Wang, N.H. The chemical constituents of root of *Angelica laxifoliata* Diels. *J. Plant Resour. Environ.* **1999**, *8*, 1–5.
40. Song, P.P.; Xu, Z.R.; Wang, N.H. Studies on the chemical constituents in roots of *Angelica tianmuensis* and *A. megaphylla*. *J. Chin. Med. Mater.* **2010**, *33*, 1249–1251.
41. Wang, Y. Optimization of extraction technology of ferulic acid from *A. megaphylla*. *J. Jiangxi Univ. TCM* **2018**, *30*, 97–100.
42. Sun, S.; Kong, L.Y.; Zhang, H.Q.; He, S.A. Structural determination of chromone from *Angelica morri* Hayata. *Chin. J. Nat. Med.* **2005**, *3*, 97–100.
43. Sun, S.; Liu, B.; Kong, L.Y.; Zhang, H.Q.; He, S.A. Chemical Study on *Angelica morri* Hayata. *J. China Pharm. Univ.* **2002**, *33*, 181–183.
44. Tang, L.X. Identification of pharmacokinetics of *Angelica grosserrata* Maxim. *Strait Pharm. J.* **1999**, *11*, 48–49.
45. Song, P.P.; Lv, Y.; Xu, Z.L.; Jiang, Q.; Wang, N.H. Chemical Constituents of *Angelica nitida* roots. *J. Chin. Med. Mater.* **2014**, *37*, 55–57.
46. Yang, Y.; Zhang, Y.; Ren, F.X.; Yu, N.J.; Xu, R.; Zhao, Y.M. Chemical constituents from the roots of *Angelica polymorpha* Maxim. *Acta Pharm. Sin.* **2013**, *48*, 718–722.
47. Zhan, Y.H. *Chinese Materia Medica Resources in Shennongjia*; Hubei Science and Technology Press: Wuhan, China, 1994; p. 418.
48. Katakai, M.S.; Kakoti, B.B. Women's ginseng (*Angelica sinensis*): An ethnopharmacological dossier. *Curr. Tradit. Med.* **2015**, *1*, 26–40. [[CrossRef](#)]
49. Upton, R. *American Herbal Pharmacopoeia and Therapeutic Compendium: Dang Gui Root-Angelica Sinensis (Oliv.)*; American Herbal Pharmacopoeia and Therapeutic Compendium: Scotts Valley, CA, USA, 2003.
50. Zhou, A.L.; Du, F.M. Separation of coumarin components from *Angelica omeiensis* root. *Chin. Trad. Herb. Drugs.* **1982**, *13*, 6–8.
51. Rao, G.X.; Liu, Q.X.; Dai, Z.J.; Yang, Q.; Dai, W.S. Textual research and discussing modern variety of *Peucedanum praeruptorum* Dunn, Chinese herb. *J. Yunnan Coll. Tradit. Chin. Med.* **1995**, *18*, 1–6+11.
52. Tan, H.; Ma, C.Y.; Geng, Y. Advancement in studies of chemical constituents and pharmacological activities of *Anthriscus sylvestris*. *Chin. Arch. Tradit. Chin. Med.* **2017**, *35*, 1194–1196.
53. Liu, Y.S. The research and function of *Oenanthe javanica*. *J. Sichuan TCM* **2004**, *22*, 25–26.
54. Marongiu, B.; Piras, A.; Porcedda, S.; Falconieri, D.; Maxia, A.; Frau, M.A.; Gonçalves, M.J.; Cavaleiro, C.; Salgueiro, L. Isolation of the volatile fraction from *Apium graveolens* L. (Apiaceae) by supercritical carbon dioxide extraction and hydrodistillation: Chemical composition and antifungal activity. *Nat. Prod. Res.* **2012**, *27*, 1521–1527. [[CrossRef](#)]

55. Zhang, H.Q.; Yuan, C.Q.; Wang, N.H. The chemical constituents of the root of *Archangelica brevicaulis* (Rupr.) Rchb. *J. Plant Resour. Environ.* **1999**, *8*, 22–25.
56. Pan, S.L.; Shun, Q.S.; Bai, Q.M. *The Coloured Atlas of the Medicinal from Genus Bupleurum in China*; Shanghai Scientific and Technological Literature Press: Shanghai, China, 2002.
57. Yang, Z.Y.; Liu, S.F.; Chao, Z.; Pan, S.L. The content of saikosaponin a, c and d in four species of *Bupleurum* in Xinjiang by HPLC. *China J. Chin. Mater. Med.* **2008**, *33*, 460–461.
58. Wei, X.M.; Yan, H.; Lu, Y.Y.; Ma, S.Y.; Cheng, X.L.; Wei, F. HPLC simultaneous determination of 6 main saponins in *Bupleurum bicaule* Helm. *J. Pharm. Anal.* **2018**, *38*, 618–622.
59. Zhu, Z.J.; Pan, R.L.; Si, J.Y.; Fu, Y.; Huang, Q.Q. Study on the chemical constituents of *Bupleurum bicaule* Helm. *Nat. Prod. Res. Dev.* **2008**, *20*, 833–835.
60. Jin, H.F.; Jiang, Y.; Luo, S.Q. Studies on the chemical constituents of roots of *Bupleurum longicaule* Wall. ex DC. var. *francheti* de Boiss and *B. chaishoui* Shan et Sheh. *China J. Chin. Mater. Med.* **1996**, *21*, 739–741+762.
61. Zhu, Z.B.; Liang, Z.S.; Han, R.L.; Dong, J.E. Growth and saikosaponin production of the medicinal herb *Bupleurum chinense* DC. under different levels of nitrogen and phosphorus. *Ind. Crops. Prod.* **2009**, *29*, 96–101. [[CrossRef](#)]
62. Zhu, Z.B.; Liang, Z.S.; Han, R.L.; Wang, X. Impact of fertilization on drought response in the medicinal herb *Bupleurum chinense* DC.: Growth and saikosaponin production. *Ind. Crops. Prod.* **2009**, *29*, 629–633. [[CrossRef](#)]
63. Huang, H.Q.; Wang, X.H.; Fu, H.; Wang, Y.; Yang, S.H. Research progress on medicinal plant resources of *Bupleurum* L. *Chin. Tradit. Herb. Drugs* **2017**, *48*, 2989–2996.
64. Ou, X.L.; Huang, T.Y. Research progress on chemical constituents of *Bupleurum*. *J. Chin. Med. Mater.* **2021**, *44*, 749–755.
65. Li, G.H.; Luo, Y.Y.; Wang, Y.; Yuan, C.Q.; Wang, N.H. Analysis of saikosaponins in medicinal *Bupleurum* spp. *J. Plant Resour. Environ.* **1996**, *5*, 59–60.
66. Shih, Y.C.; Lee, L.T.; Hu, N.Y.; Tong, T.S. Method for Treating or Relieving Inflammatory Bowel Disease. U.S. Patent 2013022694-A1, 24 January 2013.
67. Liu, Z.B.; Sun, Y.S.; Wang, J.H.; Li, S.H.; Huang, H.M. HPLC determination of saikosaponins a, c, and d in different parts of *Bupleurum falcatum*. *Chin. J. Pharm. Anal.* **2011**, *31*, 225–227.
68. Ma, X.C.; Chen, S.P.; Wang, J.H.; Li, J.Y.; Xie, Y.L. Planting density affects dry material accumulation and saikosaponin contents of *Bupleurum falcatum* L. *J. Shandong Agric. Univ. (Nat. Sci.)* **2011**, *42*, 65–69.
69. Feng, S.J. Brief Report on Chemical Constituents of *Bupleurum chinensis*. *Chin. Tradit. Herb. Drugs* **1981**, *12*, 30.
70. Zhang, G.X.; Wang, H.; Yin, X.; Kong, W.J.; Wang, Q.L.; Chen, Y.; Wei, J.H.; Liu, J.X.; Guo, X.W. Characterization of the complete chloroplast genome of *Bupleurum hamiltonii* N. P. Balakr. (Apiaceae) and its phylogenetic implications. *Mitochondrial DNA B* **2021**, *6*, 447–449. [[CrossRef](#)] [[PubMed](#)]
71. Liu, L.J.; Tian, Z.K.; Wang, X.K. Study on volatile oil composition of *Bupleurum komarovianum* Lincz. *Chin. Pharm. J.* **1993**, *28*, 239.
72. Tian, Z.K.; Ma, Y.L.; Liu, L.J.; An, F.T.; Wang, X.K.; Wang, L. Studies on the saponin components of *Bupleurum Komarovianum* Lincz. *J. Shenyang Coll. Pharm.* **1993**, *10*, 82–84+93.
73. Shi, B.; Liu, W.; Wei, S.P.; Wu, W.J. Chemical composition, antibacterial and antioxidant activity of the essential oil of *Bupleurum longiradiatum*. *Nat. Prod. Commun.* **2010**, *5*, 1139–1142. [[CrossRef](#)] [[PubMed](#)]
74. Yan, J.; Wei, Y.F.; Gu, R.; Kang, M. Content determination of saikosaponin a, c, d in overground and underground part of 4 species of *Bupleurum* Radix from Sichuan by HPLC. *Chin. J. Exp. Tradit. Med. For.* **2014**, *20*, 73–76.
75. Yan, J.; Wei, Y.F.; Zhou, Y.L.; Long, F.; Kang, L.; Chen, W.; Xu, Y. Study on HPLC characteristic map of the overground part of *Bupleurum* from Sichuan. *J. Chin. Med. Mater.* **2019**, *42*, 773–777.
76. Yan, J.; Yan, Y.M.; Wei, Y.F.; Wu, W.J. Chemical constituents of aerial part of *Bupleurum malconense*. *Chin. Tradit. Herb. Drugs* **2017**, *48*, 1282–1285.
77. Aoyagi, H.; Kobayashi, Y.; Yamada, K.; Yokoyama, M.; Kusakari, K.; Tanaka, H. Efficient production of saikosaponins in *Bupleurum falcatum* root fragments combined with signal transducers. *Appl. Microbiol. Biotechnol.* **2001**, *57*, 482–488. [[PubMed](#)]
78. Ma, Y.; Liu, K.K.; Pu, X.; Cui, Z.J.; Wang, Z.H.; Zhao, W.L.; Guo, Y.X.; Jin, L. Investigation on the Resources of *Bupleurum* in Central Gansu. *Mod. Chin. Med.* **2022**, *24*, 2119–2125.
79. Guo, S.Q.; Chi, X.X.; Bai, Y.J.; Wang, H.G. Determination of saikosaponin d in *Bupleurum Sibiricum* Vest by HPLC. *Chin. J. Ethnomed. Ethnoph.* **2020**, *29*, 44–47.
80. Song, Z.Z.; Jia, Z.J. Studies on the Chemical Components of *Bupleurum Sibiricum* Vest (I). *J. Lanzhou Univ. (Nat. Sci.)* **1992**, *28*, 99–103.
81. Liu, L.Z.; Ji, X.J.; Xu, L.X.; Zhang, Y.; Zhang, F.J.; Li, D.C.; Ya, B.Q. Quality standards of *Bupleurum Smithii* Radix. *Chin. J. Exp. Tradit. Med. For.* **2014**, *20*, 105–109.
82. Zhang, T.T.; Gao, S.; He, J.H. Research progress on chemical composition and pharmacological action of *Bupleurum smithii* Wolff. *J. Chin. Med. Mater.* **2013**, *36*, 1542–1545.
83. Li, Y.L.; Han, Q.; Lv, J.X.; Wang, J.X.; Zhao, Y.Y. Study on chemical constituents of the essential oil of *Bupleurum yinchowense*. *Chin. Tradit. Herb. Drugs* **1997**, *28*, 650–651.
84. Liu, X.L.; Shang, Z.J. Reopening discussion on original plants of “Yinzhouchaihu”. *J. Chin. Med. Mater.* **1994**, *17*, 40–42+56.
85. Pang, M.; Cui, X.M. Extraction of *Carum carvi* L. essential oil by supercritical carbon dioxide and its composition analysis. *Food Mach.* **2022**, *38*, 175–179+194.



86. Shen, N.D.; Wei, M.Q.; Li, N. Progress of *Carum carvi* L.'s economic value and researching on it's development and utilization. *J. Qinghai Norm. Univ. (Nat. Sci.)* **2010**, *1*, 54–56.
87. Xiang, J.M.; Xiao, W.; Xu, L.J.; Xiao, P.G. Research progress in *Centella asiatica*. *Mod. Chin. Med.* **2016**, *18*, 233–238+258.
88. Ji, X.; Xuan, H.B.; Huang, B.K. Overview of studies on active constituents and pharmacological actions of *Changium smyrnioides*. *J. Pharm. Pract.* **2015**, *33*, 102–105+137.
89. Chen, D.D.; Peng, C. Research progress of *Chuanmingshen violaceum*. *China Pharm.* **2011**, *20*, 1–2.
90. Chen, H.L.; Su, X.L.; Deng, Y.; Yu, T.; Zhang, H.B.; Zhang, M. Chemical constituents from the bioactive extract of *Chuanminshen violaceum*. *Chin. Tradit. Pat. Med.* **2008**, *30*, 1334–1336.
91. Fan, J.; Feng, H.B.; Yu, Y.; Sun, M.X.; Liu, Y.R.; Li, T.Z.; Sun, X.; Liu, S.J.; Sun, M.D. Antioxidant activities of the polysaccharides of *Chuanminshen violaceum*. *Carbohydr. Polym.* **2017**, *157*, 629–636. [[CrossRef](#)] [[PubMed](#)]
92. Wang, H.M.; Feng, J. Study on chemical components of volatile oil of *Cicuta virosa* L. root. *J. Tianjin Med. Univ.* **2000**, *6*, 376–377.
93. Tian, B.; Qu, X.L.; Lin, Y.P.; Yuan, Q.H.; Song, Y. Research progress on chemical constituents and pharmacological effects of *Cnidium monnieri* (L.) Cuss. *Pharm. Clin. Chin. Mater. Med.* **2020**, *11*, 70–73+80.
94. Wang, Y.P.; Wang, Y.H.; Zhan, Z.L.; Li, G. Herbal textual research on *Ligustici Rhizoma* et Radix in famous classical formulas. *Chin. J. Exp. Tradit. Med. For.* **2022**, *28*, 68–81.
95. Xue, Y.C.; Wang, N.H.; Zhang, H.Q. Studies on the chemical constituents of the root of *Conioselinum vaginatum* (Spreng.) Thell. *J. China Pharm. Univ.* **1996**, *27*, 267–270.
96. Ran, X.D. *Chinese Medicine*; Harbin Publishing House: Harbin, China, 1993; p. 1226.
97. Vetter, J. Poison hemlock (*Conium maculatum* L.). *Food Chem. Toxicol.* **2004**, *42*, 1373–1382. [[CrossRef](#)]
98. Mandal, S.; Mandal, M. Coriander (*Coriandrum sativum* L.) essential oil: Chemistry and biological activity. *Asian Pac. J. Trop. Biomed.* **2015**, *5*, 421–428. [[CrossRef](#)]
99. Li, S.H.; Niu, Y.Y. Study on chemical constituents in *Cryptotaenia japonica*. *Chin. Tradit. Herb. Drugs* **2012**, *43*, 2365–2368.
100. Lu, J.; Zhang, J.Q.; Zhao, P.R.; Liu, T.; Wen, Y.; Li, Z.H. Study on chemical compositions, antioxidant activity and antibacterial activity of essential oil from *Cryptotaenia japonica*. *Non. For. Res.* **2017**, *35*, 100–104.
101. Gachkar, L.; Yadegari, D.; Rezaei, M.B.; Taghizadeh, M.; Astaneh, S.A.; Rasooli, I. Chemical and biological characteristics of *Cuminum cyminum* and *Rosmarinus officinalis* essential oils. *Food Chem.* **2007**, *102*, 898–904. [[CrossRef](#)]
102. Zhong, W.J.; Cao, L.; Zhong, W.H.; Liang, J.; Zhong, G.Y. Analysis of varieties and standards of Umbelliferae medicinal plants used in Tibetan medicine. *World Sci. Tech./Mod. Tradit. Chin. Med. Mat. Med.* **2016**, *18*, 582–589.
103. Cui, C.Y.; Xiao, L.; Yang, Y.T.; Li, Q. Research progress in chemical constituents and pharmacological activities of *Carotae fructus*. *Liaoning Chem. Ind.* **2020**, *49*, 651–654.
104. Wu, Y.; Xu, Z.L.; Li, H.; Meng, X.Y.; Bao, Y.L.; Li, Y.X. Components of essential oils in different parts of *Daucus carota* L. var. *sativa* Hoffm. *Chem. Res. Chin. Univ.* **2006**, *22*, 328–334. [[CrossRef](#)]
105. Guan, L.L.; Pang, Y.X.; Zhang, Y.B.; Yu, F.L.; Zhang, X.R.; Chen, Z.X. Research progress on *Eryngium foetidum* L.—A Chinese minority medicine. *Chin. J. Trop. Agric.* **2013**, *33*, 23–26.
106. Sun, T.Z.; Jia, Y.M.; Bao, Z.Y. Recent clinical application and development suggestions of *Ferula breals* kuan. *China Int. TCM Expo. TCM Acad. Exch. Conf.* **2003**, *2*, 59–60.
107. Yang, X.W. Bioactive Material Basis of Medicinal Plants in Genus *Ferula*. *Mod. Chin. Med.* **2018**, *20*, 123–144.
108. Xinjiang Institute Biological Soil Desert Research. *Medicinal Flora of Xinjiang*; Place Xinjiang People's Publishing House: Urumchi, China, 1977; pp. 116–117.
109. Yang, M.H.; Tang, D.P.; Sheng, P. Research progress of *Ferula ferulaeoides*. *Chin. J. Mod. Appl. Pharm.* **2020**, *37*, 2031–2041.
110. Aybek, R.; Nilufar, M.; Keyser, S. Determination of volatile oil and ferulic acid in different parts of wild *Ferula sinkiangensis* K. M. Shen and *Ferula fukanensis* K. M. Shen Cultivars. *Med. Plant* **2018**, *9*, 36–38.
111. Li, J.; Xu, H.Y.; Jia, X.G.; Tian, S.G. Research progress on chemical constituents and biological activities of *Ferula* L. *J. Xinjiang Med. Univ.* **2012**, *35*, 1159–1161.
112. Zhang, Y.L.; Kai, S.; Su, L.M.; Wang, G.P. Advances in studies of *Ferula fukanensis*. *J. Xinjiang Univ. (Nat. Sci. Ed.)*. **2007**, *24*, 156–159.
113. Li, X.Y.; Li, G.Y.; Wang, H.Y.; Wang, Y.; Wang, J.H. Chemical constituents from *Ferula Lehmannii* Boiss. *Mod. Chin. Med.* **2010**, *12*, 17–20.
114. Huang, Y.T.; Yue, L.J.; Shen, X.Y.; Wang, K.; Liu, C.L. Chemical constituents and pharmacological activities of *Ferula sinkiangensis* K.M. Shen: Research advances. *J. Int. Pharm. Res.* **2017**, *44*, 495–499.
115. Lai, X.H.; Yang, X.R. Research progress on endangered medicinal plants *Ferula sinkiangensis*. *Mod. Agric. Sci. Technol.* **2022**, *11*, 43–47+51.
116. Yang, J.R.; Li, G.Q.; Li, Z.H.; Qin, H.L. Chemical constituents from *Ferula teterrima*. *Nat. Prod. Res. Dev.* **2006**, *18*, 246–248.
117. Su, H.H.; Zhan, L.L.; Ma, J.S. Extraction, component analysis of volatile oil from *Foeniculi Fructus* and its application in animal husbandry. *Heilongjiang Anim. Sci. Vet. Med.* **2022**, *15*, 37–40+46.
118. Pavela, R.; Žabka, M.; Bednář, J.; Tríska, J.; Vrchotová, N. New knowledge for yield, composition and insecticidal activity of essential oils obtained from the aerial parts or seeds of fennel (*Foeniculum vulgare* Mill.). *Ind. Crops Prod.* **2016**, *83*, 275–282. [[CrossRef](#)]

119. Ren, B.W.; Cai, X.T.; Li, D.L. Research progress on chemical constituents and pharmacological effects of *Glehnia littoralis*. *Light Text. Ind. Fujian Light Text Ind. Fujian* **2022**, *8*, 9–17.
120. Gao, B.X.; Lan, Z.Q.; Deng, J.J.; Wu, T.T.; Man, X.K.; Lu, X.M. HPLC fingerprint of *Heracleum candicans* roots. *Chin. J. Exp. Tradit. Med. For.* **2015**, *21*, 61–63.
121. Du, X.; Wang, Y.P.; Qian, Z.X.; Yang, H.J.; Liu, H.H.; Zhan, Z.L. Herbal textual research on *Angelicae Pubescentis* Radix and *Notopterygii Rhizoma* et Radix in famous classical formulas. *Chin. J. Exp. Tradit. Med. For.* **2023**, *9*, 68–83.
122. Zhao, Y.; He, X.J.; Zhang, Q.Y.; Ma, Y.H.; Miao, A.Q. Anatomical studies on medicinal part of *Heracleum*. *J. China West Norm. Univ. (Nat. Sci.)*. **2004**, *25*, 63–67.
123. Ma, X.; Song, P.S.; Zhu, J.R.; Zhao, J.B.; Zhang, B.C. Analysis of volatile oil from Radix *Angelicae Pubescentis* and Radix *Heraclei* in Gansu by GC-MS. *Chin. J. Mod. Appl. Pharm.* **2005**, *22*, 44–46.
124. Zhang, C.Y.; Zhang, B.G.; Yang, X.W. GC-MS analysis of essential oil from the radix of *Heracleum hemsleyanum* Diels. *Res. Inf. Tradit. Chin. Med.* **2005**, *7*, 9–12.
125. Sun, H.D. The study of the Chinese drugs of Umbelliferae V The chemical components of *Heracleum henryi* Woff. *Acta Bot. Yunnanica* **1982**, *3*, 279–281.
126. Feng, J.T.; Zhu, M.J.; Yu, P.R.; Li, Y.P.; Han, J.H.; Hao, H.J.; Ding, H.X.; Zhang, X. Screening on the resouces of botanical fungicides in Northwest China. *J. Northwest A&F Univ. (Nat. Sci. Ed.)*. **2002**, *30*, 129–133+137.
127. Zhang, Z.X.; Feng, J.T.; Zhang, X. GC-MS analysis of volatile oils from *Heracleum moelendorffii*. *Appl. Chem. Ind.* **2006**, *35*, 809–810+813.
128. IMM; PUMCH; College, I.o.M.M.C.A.o.M.S.P.U.M. *Chinese Traditional Medicine*; People's Medical Publishing House: Beijing, China, 1982.
129. Chinese Materia Medica. *Chinese Materia Medica*; Shanghai Scientific & Technical Publishers: Shanghai, China, 1999.
130. Sun, H.D.; Lin, Z.W.; Niu, F.D. The study of the Chinese drugs of Umbelliferae I, Study on chemical composition of *Angelica apaiensis* Shan, *Heracleum rapula*, and *Heracleum scabriduum*. *Acta Bot. Sin.* **1978**, *20*, 244–254.
131. Wei, C.C.; Guan, W.J.; Hu, D.D.; Zhou, J.; Li, X. Chemical constituents from *Heracleum scabridum*. *J. Chin. Med. Mater.* **2017**, *40*, 1105–1108.
132. Lin, Z.W.; Gao, L.; Rao, G.X.; Pu, F.D.; Sun, H.D. Coumarins of *Heracleum stenopterum*. *Acta Bot. Yunnanica* **1993**, *15*, 315–316.
133. Rao, G.X.; Wu, Y.; Dai, W.S.; Pu, F.D.; Lin, Z.W.; Sun, H.D. Coumarins of *Heracleum yunnanense* Hand.-Mass. *China J. Chin. Mater. Med.* **1993**, *18*, 736–737+763.
134. Dong, G.T.; Song, L.K.; Tang, H.; Wang, Y.; Wang, X.N. Determination of asiaticoside and madecassoside in *Hydrocotyle*. *Chin. Wild Plant Res.* **2012**, *31*, 47–50.
135. Xiong, J.; She, J.M.; Liu, H.W.; Cao, L.Q.; Xiao, Y. Advances of chemical constituents and pharmacological effects of *Hydrocotyle* genus. *Asia-Pac. Tradit. Med.* **2019**, *15*, 179–183.
136. Xu, Y.F.; Chen, Y.H.; Yang, S.P. Review of chemical constituents and pharmacological effects of *Hydrocotyle* genus. *Fujian Sci. Tech. Trop. Crops* **2013**, *38*, 59–61.
137. Central Information Station of Chinese Herbal Medicine of State Medicine Administration. *Handbook of Effective Components of Plant Medicine*; People's Medical Publishing House: Beijing, China, 1986.
138. Kang, W.Y.; Zhao, C.; Mu, S.Z.; Yang, X.S.; Hao, X.S. Chemical composition analysis of volatile oil of *Hydrocotyle sibthorpioides* Lam. *Chin. Tradit. Herb. Drugs* **2003**, *34*, 116–117.
139. He, X.P.; Wang, X.Y. Research progress of Tibetan materia medica *Pleurospermum hookerivar.* *Asia-Pac. Tradit. Med.* **2018**, *14*, 22–24.
140. Yuan, M.; Li, Y.Z.; Xu, M.; Zhao, X.H. Pharmacodynamic study on anti-inflammatory and analgesic effects of Tibetan medicine *Pleurospermum hookeri* var. *thomsonii*. *Nat. Prod. Res. Dev.* **2012**, *24*, 972–975.
141. Zhao, L.Q. Research advancement on terpenoids in *Ligusticum* and their biological activity. *Lishizhen Med. Mater. Med. Res.* **2006**, *17*, 16–18.
142. Li, T.; Wang, T.Z.; Wu, W.B. Plants of the *Pleurospermum* with potential medicinal value. *J. Chin. Med. Mater.* **2002**, *25*, 12–13.
143. Liu, Y.; Wei, H.Y.; Yao, S.H.; Zheng, X.Z. Comparison of pharmacological effects of traditional Chinese medicine *Qianhu* expectorant. *Hunan Guiding J. TCM* **1997**, *3*, 40–42.
144. Wang, H.H.; Hu, S.F. Research in *Levisticum officinale* Koch. *China Med. Her.* **2011**, *8*, 11–12.
145. Ge, X.X.; Rao, C.; Bian, M.; Cao, L. Analysis of essential oil from the roots of *Libanotis buchtormensis* and antibacterial activity test. *J. Nanjing Norm. Univ. (Eng. Technol. Ed.)*. **2015**, *15*, 67–72.
146. Tang, X.S.; Yang, D.M.; Zhu, K.X. Analysis of essential oil from *Libanotis laticalycina* Shan et Sheh. by CC-MS. *China J. Chin. Mater. Med.* **1992**, *17*, 40–42+48.
147. Wang, J.H.; Lou, Z.C. Plant origin of commercial drug *Saposhnikovia divaricata*. *J. Tradit. Chin. Med. Bull.* **1988**, *13*, 9–10+62.
148. Huang, Y.Z.; Pu, F.D. Study on the chemical components of the essential oil from *Ligusticum brachylobum* Franch. *China J. Chin. Mater. Med.* **1990**, *15*, 38–39+63.
149. Yunnan Institute of Materia Medica. *Illustrated Handbook for Natural Medicine in Yunnan (IV)*; Yunnan Science and Technology Press: Kunming, China, 2007; p. 93.
150. Li, X.F.; Qiu, B. Studies on pharmacognosy of radix *Ligusticum Brachylobum* Franch. *J. Guangzhou Univ. TCM* **2020**, *37*, 1151–1154.
151. Zhang, X.J.; Zhang, Y.L.; Zuo, D.D. Research progress on chemical constituents and pharmacological effects of *Ligusticum chuanxiong* Hort. *Inf. Tradit. Chin. Med.* **2020**, *37*, 128–133.

152. Lu, X.Y.; Sun, Q.S.; Zhang, M.N.; Zhao, J.Z. Isolation and identification of chemical constituents from rhizome and root of *Ligusticum jeholense* Nakai et Kitag. *J. Shenyang Pharm. Univ.* **2010**, *27*, 434–435+439.
153. Zhang, M.F.; Shen, Y.Q. Study on pharmacology and meridians of *Ligusticum*. *Shanghai Pharma.* **2006**, *27*, 415–418.
154. Rao, G.X.; Dai, Y.H.; Wang, L.X.; Cai, F.; Lin, Z.W.; Sun, H.D. Chemical constituents from *Ligusticum pteridophyllum*. *Acta Bot. Yunnanica* **1991**, *13*, 233–236.
155. Tang, Z. Studies on chemical constituents and pharmacology of *Ligusticum sinense* Oliv. *Guide China Med.* **2011**, *9*, 34–35.
156. Wang, W.N.; Sun, Q.S.; Liang, J.; Zhang, Z.C. A pharmacognostic study of *Ligusticum tenuissimum* (nakai) Kitag. *J. Shenyang Coll. Pharm.* **1991**, *8*, 182–187.
157. Tang, G.L.; Huang, F.; Gao, T.Y.; Wu, Q.M.; Yu, W.; Qiu, H.; Jiang, G.H. Simultaneous determination of five components in *Notopterygium franchetii* H. de Boiss. by HPLC. *Pharm. Clin. Chin. Mater. Med.* **2018**, *9*, 14–17.
158. Zhang, L.L. Pharmacological effects and application of traditional Chinese medicine *Notopterygium*. *China Contin. Med. Educ.* **2015**, *7*, 191–192.
159. Ye, H.G.; Li, C.Y.; Ye, W.C.; Zeng, F.Y.; Liu, F.F.; Liu, Y.Y.; Wang, F.G.; Ye, Y.S.; Fu, L.; Li, J.R. Common Chinese Materia Medica, Medicinal Angiosperms of Umbelliferae. In *Common Chinese Materia Medica: Volume 6*; Ye, H.G., Li, C.Y., Ye, W.C., Zeng, F.Y., Eds.; Springer Nature: Singapore, 2022; pp. 199–296.
160. Guo, X.Q.; Wei, L.H.; Dai, T.T.; Wu, Q. The detection of the chemical components in *Oenanthe javanica* and its hypoglycemic activity. *Food Mach.* **2017**, *33*, 155–157+173.
161. Li, Y.T.; Zhu, C.H.; Sun, F.F.; Wei, X. Modern research progress of *Ostericum citriodorum*. *Guangdong Chem. Ind.* **2020**, *47*, 97–100.
162. Tian, W.Y.; Lan, F.; Li, S.P.; Luo, J.Y. Preliminary pharmacological study of *Angelica citriodora* Hance. *Chin. Pharmacol. Bull.* **1989**, *5*, 249.
163. Zhang, J.; Li, R.M.; Wei, G. Study on chemical constituents of volatile oil of *Ostericum citriodorum*. *Chin. Tradit. Herb. Drugs* **2009**, *40*, 1221–1222.
164. Xue, Y.C.; Xian, Q.M.; Zhang, H.Q. Chemical constituents of the essential oil from the root of *Ostericum grosseserratum* (Maxim.) Kitag. *J. Plant Resour. Environ.* **1995**, *4*, 61–63.
165. Xue, Y.C.; Zhang, H.Q.; Wang, N.H.; Yuan, C.Q. Studies on chemical constituents of the roots of *Ostericum grosseserratum* (Maxim.) Kitag. *China J. Chin. Mater. Med.* **1992**, *17*, 354–356+383.
166. Ebadollahi, A. Plant essential oils from Apiaceae family as alternatives to conventional insecticides. *Ecol. Balk.* **2013**, *5*, 149–172.
167. Sousa, R.M.O.F.; Cunha, A.C.; Fernandes-Ferreira, M. The potential of Apiaceae species as sources of singular phytochemicals and plant-based pesticides. *Phytochemistry* **2021**, *187*, 112714. [[CrossRef](#)]
168. Wang, Y.H.; Zhao, J.C.; Weng, Q.Q.; Jin, Y.; Zhang, W.; Peng, H.S. Textual research on classical prescriptions of *Saposhnikovia Radix*. *Mod. Chin. Med.* **2020**, *22*, 1331–1339.
169. Ji, L.; Pan, J.G.; Yang, J.; Xiao, Y.Q. GC-MS analysis of essential oils from the roots of *Saposhnikovia divaricata* (Turcz.) Schischk, *Libanotis laticalycina* Shan et Sheh, *Seseli yunnanense* Franch. and *Peucedanum dielsianum* Fedde ex Wolff. *China J. Chin. Mater. Med.* **1999**, *24*, 678–680+702.
170. Yan, Y.N.; Ding, S.F.; Guo, Y.W.; Tian, H.K.; Zuo, M.J. Study on customary medication in windbreak area I-Pharmacokinetics and chemical constituents of *Saposhnikovia divaricata*. *Northwest Pharm. J.* **1988**, *3*, 31–34.
171. Kong, L.Y.; Pei, Y.H.; Yu, R.M.; Li, X.; Zhu, Y.R. Overview of the chemical and pharmacological research of the Chinese medicine *Peucedanum praeurptorum* and *P. Decursivum*. *World Notes Plant Med.* **1991**, *6*, 243–254.
172. Li, W.; Feng, S.H.; Hu, F.D.; Chen, E.L. Goumarins from *Peucedanum harry-smithii* var. *subglabrum*. *China J. Chin. Mater. Med.* **2009**, *34*, 1231–1234.
173. Shi, Y.R.; Kong, L.Y. Exploration of thinking and method in study of active components of Chinese medicine by taking radix *Peucedani* for example. *Mod. Tradit. Chin. Med. Mater. Mater.-World Sci. Technol.* **2005**, *7*, 38–46+137.
174. Song, P.S.; Ding, Y.H.; Zhang, B.C.; Yang, J.; Jing, F.L.; Cheng, J.S.; Wang, A.P.; Song, L.; Lin, F. Investigation and identification of *Peucedanum praeurptorum* in Gansu. *J. Chin. Med. Mater.* **1994**, *17*, 13–14+55.
175. Li, L.H.; Zhang, H.B.; Yang, C.Z.; Cai, D.L. Analysis of volatile oils from different parts of *Peucedanum japonicum* by GC-MS. *Subtrop. Plant Sci.* **2015**, *44*, 279–283.
176. Xu, X.; Li, H.F. Analysis of medicinal value of *Peucedanum japonicum*. *Asia-Pac. Tradit. Med.* **2016**, *12*, 45–47.
177. Barot, K.P.; Jain, S.V.; Kremer, L.; Singh, S.; Ghate, M.D. Recent advances and therapeutic journey of coumarins: Current status and perspectives. *Med. Chem. Res.* **2015**, *24*, 2771–2798. [[CrossRef](#)]
178. Lei, H.P.; Zou, S.Y.; Zhang, H.; Ge, F.H. Composition analysis of volatile oil from three kinds of *Peucedanum*. *J. Chin. Med. Mater.* **2016**, *39*, 795–798.
179. Huang, P.; Zheng, X.Z.; Lai, M.X.; Rao, W.Y.; Nishi, M.; Nakanishi, T. Studies on chemical constituents of *Peucedanum medium* Dunn var. *garcile* Dunn ex Shan at Sheh. *China J. Chin. Mater. Med.* **2000**, *25*, 222–224.
180. Song, Z.Q.; Li, B.; Tian, K.Y.; Hong, L.; Wu, W.; Zhang, H.Y. Research progress on chemical constituents and pharmacological activities of *Peucedanum praeurptorum* Dunn. *Chin. Tradit. Herb. Drugs* **2021**, *3*, 1–16.
181. Dai, W.S.; Rao, G.X.; Liu, Q.X.; Yang, Q.; Dai, Y.H.; Sun, H.D. Chemical constituents of *Peucedanum rubricaulis*. *J. Yunnan Coll. Tradit. Chin. Med.* **1995**, *18*, 1–4.
182. Rao, G.X.; Huang, H.; Sun, H.D. Terpenoids from *Peucedanum rubricaulis*. *Nat. Prod. Res. Dev.* **2006**, *18*, 69–70.

183. Rao, G.X.; Sun, H.D.; Lin, Z.W.; Hu, R.Y. Studies on the chemical constituents of the traditional Chinese medicine “yun qian-hu” (*Peucedanum Rubricaula* Shan et Shch. *Acta Pharm. Sin.* **1990**, *26*, 30–36.
184. Yu, Z.P.; Li, J.J.; Rao, G.X.; Yu, Z.R. Brief pharmacological studied on *Peucedanum Praerptorum* Dunn habitually used in Southwest Arep. *J. Yunnan Coll. Tradit. Chin. Med.* **1995**, *18*, 7–11.
185. Rao, G.X.; Liu, Q.X.; Dai, W.S.; Sun, H.D. Chemical constituents of *Peucedanum turgeniifolium*. *Nat. Prod. Res. Dev.* **1997**, *9*, 9–11.
186. Wu, X.L.; Kong, L.Y.; Min, Z.D. The chemical constituents of *Peucedanum wawrii* (Wolff) Su root. *J. Plant Resour. Environ.* **2000**, *9*, 6–8.
187. Abuaini, T.; Wang, Y.; Aili, S. Study on quality standards of *Pimpinella anisum* L. fruits. *J. Med. Pharm. Chin. Minor.* **2013**, *8*, 51–52.
188. Benelli, G.; Pavela, R.; Iannarelli, R.; Petrelli, R.; Cappellacci, L.; Cianfaglione, K.; Afshar, F.H.; Nicoletti, M.; Canale, A.; Maggi, F. Synergized mixtures of Apiaceae essential oils and related plant-borne compounds: Larvicidal effectiveness on the filariasis vector *Culex quinquefasciatus* Say. *Ind. Crops Prod.* **2017**, *96*, 186–195. [[CrossRef](#)]
189. Chinese Materia Medica-Uyghur Traditional Medicine. *Chinese Materia Medica, Uyghur Traditional Medicine*; Scientific & Technical Publishers: Shanghai, China, 2005; pp. 301–302.
190. Editorial Board of Chinese Medical Encyclopedia. *Chinese Medical Encyclopedia, Uyghur Traditional Medicine*; Scientific & Technical Publishers: Shanghai, China, 2005.
191. Gu, Y.S.; Gu, Y.F. *The Science of Common Medicinal Materials in Uygur Medicine (Rudin)*; Xinjiang Science and Technology Health Publishing House: Urumchi, China, 1993; pp. 60–61.
192. Sun, W.J.; Sheng, J.F. *Concise Handbook of Natural Active Ingredients*; China Medical Science Press: Beijing China, 1996.
193. Wei, Y.; Zhang, X.; Wei, L.; Yang, X.S. Analysis of volatile oil in herb of *Pimpinella candolleana*. *J. Guiyang Univ. Chin. Med.* **2005**, *27*, 56–57.
194. Zhao, C.; Chen, H.G.; Cheng, L.; Zhou, X.; Yang, Z.B.; Zhang, Y.S. Analysis of volatile oil in herb of *Pimpinella candolleana* by SPME-GC-MS. *China J. Chin. Mater. Med.* **2007**, *32*, 1759–1762.
195. Hu, L.F.; Lv, W.Y.; Zhou, L.; Li, X. Antifungal activities of five umbelliferae plant extracts against plant pathogens. *Hubei Agric. Sci.* **2012**, *51*, 3490–3491.
196. Dong, L.S.; Zhao, Z.H. Identification of raw drugs of Chinese herb *Pimpinella diversifolia*. *J. Guiyang Univ. Chin. Med.* **1991**, *13*, 62–64.
197. Dong, Q.; Li, J.; Liu, Y.F.; Yang, G.X.; Hu, Y.Y.; Jiang, Y.L.; Liu, Q. Study on the medicinal effect of extracts from *Pimpinella diversifolia*. *China Pract. Med.* **2021**, *16*, 197–200.
198. Xu, X.W.; Lin, G.Y.; Lin, C.L. Study on the chemical components of essential oil from Zhejiang *Pimpinella diversifolia*. *China Pharm.* **2012**, *21*, 3–4.
199. Cui, X.M.; Shi, H.L.; Ren, H.; Hu, J.; Meng, M.X.; Chen, J.; Meng, X.; Chen, Z.Y. Content determination of nine constituents in different medicinal parts of *Pimpinella thellungiana*. *Chin. J. Exp. Tradit. Med. For.* **2019**, *25*, 97–103.
200. Huanglong County Leading Group of Prevention and Control of Endemic Diseases in Yan’an Region. A comprehensive analysis of 92 cases of Keshan disease treated with *Pimpinella magna*. *Shaanxi Med. J.* **1972**, *1*, 34–35.
201. Jin, Z.G.; Wang, M.S. Advances in studies of herbal *Pimpinella thellungiana* Wolff. *J. Shangluo Univ.* **2008**, *22*, 43–46.
202. Liu, R.; Tai, G.; Pei, X.L.; Wang, R.; Zhang, S.R.; Pei, M.R. Determination of nine components in Yanghongshan by UPLC. *Chin. J. Pharm. Anal.* **2020**, *40*, 1097–1103.
203. Wang, J.Q.; Zhao, X.M.; Duan, X.Z. The effect of *Pimpinella thellungiana* on immune function of patients with coronary heart disease. *Shaanxi Med. J.* **1986**, *15*, 58–60.
204. Liu, Q.G.; Zhang, Z.T.; Chen, Z.G. Study on the active components of volatile oil from the seeds of *Pleurospermum giraldii* Diels. *Chin. Tradit. Herb. Drugs* **1998**, *29*, 516–517.
205. Zhang, Z.T. L-carvone the principal constituent of volatile oil from *Pleurospermum giraldii* Diels seeds effects on the smooth muscle of intestine and womb for rats. *J. Shaanxi Norm. Univ. (Nat. Sci. Ed.)*. **2000**, *28*, 77–79.
206. Zhang, Z.T.; Liu, Q.G.; He, Y.; Chen, Z.G.; Gao, Z.W. Study on the chemical components from the seeds of *Pleurospermum giraldii* Diels. *Chin. Tradit. Herb. Drugs* **1998**, *29*, 800–801.
207. Revolutionary Committee of Health Bureau of Yunnan Province. *Chinese Herbal Medicine in Yunnan*; Yunnan People’s Publishing House: Kunming, China, 1971; pp. 98–99.
208. Liu, M.Y.; Yu, L.F.; Yang, F.; Liu, P.H. Study on the adsorption of bile salts and cholesterol by water soluble constituents from *Sanicula Astrantiifolia*. *J. Qujing Norm. Univ.* **2016**, *35*, 37–41.
209. Liu, P.H.; Yang, G.H.; Tian, X.L.; Zhang, Y.G.; Li, F.S.; Wang, F. Antioxidating effects of *Inula nervosa* Wall. ex DC. on the edible oils and its antimicrobial activity. *Sci. Technol. Food Ind.* **2011**, *32*, 187–189.
210. Xu, G.M.; Wang, Z.M.; Liu, N.Z.; He, W.J.; Peng, S.; Zhou, X.J. Study on chemical constituents from ethyl acetate extraction of *Sanicula lamelligera*. *J. Chin. Med. Mater.* **2015**, *38*, 1661–1664.
211. Zhou, X.J.; Zeng, N.; Jia, M.R. Screening of effective ingredients for relieving cough and resolving phlegm in the herba *Saniculae*. *Chin. J. Ethnomed. Ethnoph.* **2005**, *72*, 46–49+62.
212. Liu, B. *China Checklist of Higher Plants*; Biodiversity Committee of Chinese Academy of Sciences, Ed.; 2022 Annual Checklist; Catalogue of Life China: Beijing, China, 2022.
213. Karagoz, A.; Turan, K.; Arda, N.; Okatan, Y.; Kuru, A. In vitro virucidal effect of *Sanicula europaea* L. extract. *Turk. J. Biol.* **1997**, *21*, 181–188. [[CrossRef](#)]



214. Turan, K.; Kuru, A. Antiviral activity of water extract of *Sanicula europaea* L. leaves on the bacteria-bacteriophage system. *Turk. J. Biol.* **1996**, *20*, 225–234. [[CrossRef](#)]
215. Hiller, K.; Linzer, B.; Pfeifer, S.; Tökes, L.; Murphy, J. On the saponins from *Sanicula europaea* L. On the knowledge of the contents of some Saniculoideae. *Pharmazie* **1968**, *23*, 376–387. [[PubMed](#)]
216. Legin, N.I.; Koliadzhyn, T.I.; Grytsyk, L.M.; Grytsyk, A.R. Investigation of the elemental composition of *Sanicula Europaea* L. and *Astrantia Major* L. *Med. Clin. Chem.* **2018**, *20*, 112–116.
217. Matsushita, A.; Miyase, T.; Noguchi, H.; Velde, D.V. Oleanane saponins from *Sanicula elata* var. *chinensis*. *J. Nat. Prod.* **2004**, *67*, 377–383. [[CrossRef](#)]
218. Chang, L.; Jing, W.G.; Cheng, X.L.; Wei, F.; Ma, S.C. Research progress on chemical constituents and pharmacological effects of *Saposhnikovia* Radix and predictive analysis on quality marker (Q-Marker). *Mod. Chin. Med.* **2022**, *24*, 2026–2039.
219. Liu, S.L.; Jiang, C.X.; Zhao, Y.; Xu, Y.H.; Wang, Z.; Zhang, L.X. Advance in study on chemical constituents of *Saposhnikovia divaricate* and their pharmacological effects. *Chin. Tradit. Herb. Drugs* **2017**, *48*, 2146–2152.
220. Gui, J.S.; Wei, Q.H. Pharmacodynamic comparison between *Seseli mairei* and *Saposhnikovia divaricata*. *J. Yunnan Coll. Tradit. Chin. Med.* **1991**, *14*, 3–6.
221. Gui, J.S.; Wei, Q.H.; Yang, S.D. Discussion on varieties of Yunnan Fangfeng. *J. Yunnan Coll. Tradit. Chin. Med.* **1991**, *14*, 23–25.
222. Zong, Y.L.; Lin, Y.P.; Ding, Q.E.; He, H.; Rao, G.X. Studies on the chemical constituents of the aerial parts of *Seselimairei*. *J. Chin. Med. Mater.* **2007**, *30*, 42–44.
223. Lin, Y.P.; Wang, J.; Hu, C.Y.; Rao, G.X. Chemical constituents from the roots of *Seseli yunnanense*. *J. Chin. Med. Mater.* **2017**, *40*, 2586–2589.
224. Xu, Y.; Chen, N.X. Comparative identification of *Ligusticum sinense* and *Sium suave*. *Heilongjiang J. Tradit. Chin. Med.* **1998**, *5*, 47–48.
225. Qin, N.; Su, Y.F.; Wang, Y.D.; Shi, J.G.; Yue, F.X.; Wu, Z.H.; Gao, X.M. Chemical constituents from *Tongoloo silaifolia*. *Biochem. Syst. Ecol.* **2012**, *44*, 380–382. [[CrossRef](#)]
226. Qin, N.; Su, Y.F.; Wang, Y.D.; Zhang, H.; Wu, Z.H.; Gao, X.M. Chemical Constituents of *Tongoloo silaifolia*. *Nat. Prod. Res. Dev.* **2013**, *25*, 201–203. [[CrossRef](#)]
227. Xu, H.N.; Mu, Y.; Zhang, Z.H.; Zhang, Z.; Zhang, D.Y.; Tan, X.Q.; Shi, X.B.; Liu, Y. Extraction and identification of volatiles from *Artemisia argyi* and *Torilis scabra* and their effects on preference of *Bemisia tabaci* MED (Hemiptera: Aleyrodidae) adults. *Acta Entomol. Sin.* **2022**, *65*, 343–350.
228. Bairwa, R.; Sodha, R.S.; Rajawat, B.S. *Trachyspermum ammi*. *Pharmacogn. Rev.* **2012**, *6*, 56. [[CrossRef](#)] [[PubMed](#)]
229. Kaur, G.J.; Arora, D.S. Antibacterial and phytochemical screening of *Anethum graveolens*, *Foeniculum vulgare* and *Trachyspermum ammi*. *BMC Complement. Altern. Med.* **2009**, *9*, 30. [[CrossRef](#)] [[PubMed](#)]
230. Kaur, G.J.; Arora, D.S. Bioactive potential of *Anethum graveolens*, *Foeniculum vulgare* and *Trachyspermum ammi* belonging to the family Umbelliferae—Current status. *J. Med. Plants Res.* **2010**, *4*, 87–94.
231. Shankaracharya, N.B.; Nagalakshmi, S.; Naik, J.P.; Rao, L.J.M. Studies on chemical and technological aspects of ajowan (*Trachyspermum ammi* (L.) Syn. *Carum copticum* Hiern) seeds. *J. Food Sci. Technol.* **2000**, *37*, 277–281.
232. Dong, S.T.; Zhang, X.Q.; Hu, Y.; Gong, X.M.; Yang, H.Q. Chemical constituents, quality control and pharmacology research progress of Xigui Chin. *J. Ethnomed. Ethnoph.* **2018**, *27*, 40–42.
233. Zhang, W.M.; Duan, Z.H.; Sun, F.; Rao, G.X. The chemical constituents from the roots of *Vicatia thibetica*. *Nat. Prod. Res. Dev.* **2004**, *16*, 218–219.
234. Zhou, N.; Duan, Y.M.; Chen, Q.; Ma, X.K. Study on pharmacognosy of Xigui. *J. Anhui Agric. Sci.* **2007**, *35*, 2307–2425.
235. Hong, Q.Y.; Zhang, J.J.; Wang, C.; Wang, L.Y.; Zhang, R.; Le, N. Discussion on the Chinese medicine properties of foreign botanical medicine *Ammi visnaga* L. *China J. Tradit. Chin. Med. Pharm.* **2022**, *37*, 2284–2288.
236. Ma, Q.D.; Li, G.Y.; Wang, J.H. Research progress on pharmacological activity of Uygur medicine *Trachyspermum ammi* fruits. *J. Nongken Med.* **2011**, *33*, 180–184.
237. Yao, H.J.; Zhao, C.Y.; Jiang, L.Q.; Lv, H.Z. Study of Pharmacognostical and HPLC Fingerprint on *Angelica acutiloba* of Korean Drugs. *J. Chin. Med. Mater.* **2018**, *41*, 1384–1390.
238. Fang, Z.X. *Annals of Tujia Medicine*; The Medicine Science and Technology Press of China: Beijing, China, 2007.
239. Wei, W.L.; Zeng, R.; Gu, C.M.; Qu, Y.; Huang, L.F. *Angelica sinensis* in China—A review of botanical profile, ethnopharmacology, phytochemistry and chemical analysis. *J. Ethnopharmacol.* **2016**, *190*, 116–141. [[CrossRef](#)]
240. Shan, H.Y.; Jiao, T.Y. Determination of ferulic acid in shiquan dabu capsules by HPLC. *Chin. Med. Mod. Distance Educ. China* **2011**, *9*, 138–139.
241. Huang, T.; Liu, D.; Cui, X.; Li, M.; Jin, L.; Paré, P.W.; Li, M.; Wei, J. In vitro bioactive metabolite production and plant regeneration of medicinal plant *Angelica sinensis*. *Ind. Crops Prod.* **2023**, *194*, 116276. [[CrossRef](#)]
242. Liu, H.B.; Lu, A.J.; Liu, B.; Zhou, J.J. Exploring relationship between traditional effects of traditional Chinese medicine and modern pharmacological activities by “co-effect compounds”. *China J. Chin. Mater. Med.* **2005**, *30*, 76–79.
243. Xing, Y.C.; Li, N.; Zhou, D.; Chen, G.; Jiao, K.; Wang, W.L.; Si, Y.Y.; Hou, Y. Sesquiterpene coumarins from *Ferula sinkiangensis* act as neuroinflammation inhibitors. *Planta Med.* **2016**, *83*, 135–142. [[CrossRef](#)]
244. Kokotkiewicz, A.; Luczkiewicz, M. Chapter 37—Celery (*Apium graveolens* var. *dulce* (Mill.) Pers.) Oils Celery (*Apium graveolens* var. *dulce* (Mill.) Pers.) Oils. In *Essential Oils in Food Preservation, Flavor and Safety*; Preedy, V.R., Ed.; Academic Press: San Diego, CA, USA, 2016; pp. 325–338.

245. Mišić, D.; Zizovic, I.; Stamenić, M.; Ašanin, R.; Ristić, M.; Petrović, S.D.; Skala, D. Antimicrobial activity of celery fruit isolates and SFE process modeling. *Biochem. Eng. J.* **2008**, *42*, 148–152. [[CrossRef](#)]
246. Meng, H.; Li, G.Y.; Huang, J.; Zhang, K.; Wang, H.Y.; Wang, J.H. Sesquiterpene coumarin and sesquiterpene chromone derivatives from *Ferula ferulaeoides* (Steud.) Korov. *Fitoterapia* **2013**, *86*, 70–77. [[CrossRef](#)]
247. Lin, L.; Qian, X.P.; Hu, J.; Hu, W.J.; Zhang, G.D.; Xie, L.; Yu, L.X. Experimental study of *Angelica pubescens* and Osthole isolated from *Angelica pubescens* anti-tumor activity in vitro. *Mod. Oncol.* **2013**, *21*, 1930–1931.
248. Martins, N.; Barros, L.; Santos-Buelga, C.; Ferreira, I.C.F.R. Antioxidant potential of two Apiaceae plant extracts: A comparative study focused on the phenolic composition. *Ind. Crops Prod.* **2016**, *79*, 188–194. [[CrossRef](#)]
249. Yuan, C.Q. Synopsis of Chinese medicinal plants of Umbelliferae. *Bull. Chin. Mater. Med.* **1986**, *11*, 5–9.
250. BeMiller, J.N. Polysaccharides: Occurrence, Structures, and Chemistry. In *Carbohydrate Chemistry for Food Scientists*, 3rd ed.; BeMiller, J.N., Ed.; AACC International Press: Cambridge, UK, 2019; pp. 75–101.
251. Li, L.; Zhou, Y.; Zhang, L. Effect of Polysaccharide of radix sileris on enhancing macrophagocyte's antineoplastic function. *J. Beijing Univ. TCM* **1999**, *22*, 38–40.
252. Zheng, Y.; Bai, L.; Zhou, Y.; Tong, R.; Zeng, M.; Li, X.; Shi, J. Polysaccharides from Chinese herbal medicine for anti-diabetes recent advances. *Int. J. Biol. Macromol.* **2019**, *121*, 1240–1253. [[CrossRef](#)]
253. Bi, S.J.; Fu, R.J.; Li, J.J.; Chen, Y.Y.; Tang, Y.P. The bioactivities and potential clinical values of *Angelica sinensis* polysaccharides. *Nat. Prod. Commun.* **2021**, *16*, 1–18. [[CrossRef](#)]
254. Dong, X.D.; Liu, Y.N.; Zhao, Y.; Liu, A.J.; Ji, H.Y.; Yu, J. Structural characterization of a water-soluble polysaccharide from *Angelica dahurica* and its antitumor activity in H22 tumor-bearing mice. *Int. J. Biol. Macromol.* **2021**, *193*, 219–227. [[CrossRef](#)] [[PubMed](#)]
255. Wang, J.M.; Lian, P.L.; Yu, Q.; Wei, J.F.; Kang, W.Y. Purification, characterization and procoagulant activity of polysaccharides from *Angelica dahurice* roots. *Chem. Cent. J.* **2017**, *11*, 1–8. [[CrossRef](#)] [[PubMed](#)]
256. Liu, Z.Z.; Weng, H.B.; Zhang, L.J.; Pan, L.Y.; Sun, W.; Chen, H.X.; Chen, M.Y.; Zeng, T.; Zhang, Y.Y.; Chen, D.F.; et al. *Bupleurum* polysaccharides ameliorated renal injury in diabetic mice associated with suppression of HMGB1-TLR4 signaling. *Chin. J. Nat. Med.* **2019**, *17*, 641–649. [[CrossRef](#)] [[PubMed](#)]
257. Wu, J.; Zhang, Y.Y.; Guo, L.; Li, H.; Chen, D.F. *Bupleurum* polysaccharides attenuates lipopolysaccharide-induced inflammation via modulating toll-like receptor 4 signaling. *PLoS ONE* **2013**, *8*, e78051. [[CrossRef](#)] [[PubMed](#)]
258. Zhang, Z.D.; Li, H.; Wan, F.; Su, X.Y.; Lu, Y.; Chen, D.F.; Zhang, Y.Y. Polysaccharides extracted from the roots of *Bupleurum chinense* DC. modulates macrophage functions. *Chin. J. Nat. Med.* **2017**, *15*, 889–898. [[CrossRef](#)]
259. Kukula-Koch, W.A.; Widelski, J. Chapter 9—Alkaloids. In *Pharmacognosy*; Badal, S., Delgoda, R., Eds.; Academic Press: Boston, MA, USA, 2017; pp. 163–198.
260. Ain, Q.U.; Khan, H.; Mubarak, M.S.; Pervaiz, A. Plant alkaloids as antiplatelet agent: Drugs of the future in the light of recent developments. *Front. Pharmacol.* **2016**, *7*, 292. [[CrossRef](#)]
261. Khan, H. Anti-inflammatory potential of alkaloids as a promising therapeutic modality. *Lett. Drug Des. Discov.* **2016**, *14*, 240–249. [[CrossRef](#)]
262. Perviz, S.; Khan, H.; Pervaiz, A. Plant alkaloids as an emerging therapeutic alternative for the treatment of depression. *Front. Pharmacol.* **2016**, *7*, 28. [[CrossRef](#)]
263. Pu, Z.H.; Dai, M.; Peng, C.; Xiong, L. Research progress on material basis and pharmacological action of *Ligusticum chuanxiong* alkaloids. *J. Funct. Foods* **2020**, *31*, 1020–1024.
264. Zhou, Y.; Liu, X.; Wang, L.Y. Effects of Chuanxiong alkaloid on myocardial fibrosis in rats. *J. Beihua Univ. (Nat. Sci.)* **2022**, *23*, 200–203.
265. Radulović, N.; Đorđević, N.; Denić, M.; Pinheiro, M.M.G.; Fernandes, P.D.; Boylan, F. A novel toxic alkaloid from poison hemlock (*Conium maculatum* L., Apiaceae): Identification, synthesis and antinociceptive activity. *Food Chem. Toxicol.* **2012**, *50*, 274–279. [[CrossRef](#)] [[PubMed](#)]
266. Deng, Y.X.; Lu, S.F. Biosynthesis and regulation of phenylpropanoids in plants. *Crit. Rev. Plant Sci.* **2017**, *36*, 257–290. [[CrossRef](#)]
267. Böttger, A.; Vothknecht, U.; Bolle, C.; Wolf, A. Phenylpropanoids. In *Lessons on Caffeine, Cannabis & Co: Plant-Derived Drugs and their Interaction with Human Receptors*; Springer International Publishing: Cham, Switzerland, 2018; pp. 171–178.
268. Spitaler, R.; Ellmerer-Müller, E.P.; Zidorn, C.; Stuppner, H. Phenylpropanoids and Polyacetylenes from *Ligusticum mutellina* (Apiaceae) of Tyrolean Origin. *Sci. Pharm.* **2002**, *70*, 101–109.
269. Wang, D.D.; Liu, H.B.; Song, H.L.; Yang, W.X.; Jia, X.G.; Tian, S.G. Determination of ferulic acid content in roots and leaves of *Ferula fukanensis* K. M. Shen. by HPLC. *J. Xinjiang Med. Univ.* **2012**, *35*, 1139–1142.
270. Wen, Q.; Wang, X.Y. Determination the content of ferulic acid in *Pleurospermum Hoffm.* by HPLC. *Chin. J. Ethnomed. Ethnopharmacol.* **2018**, *27*, 49–51.
271. Lu, G.H.; Chan, K.; Leung, K.; Chan, C.L.; Zhao, Z.Z.; Jiang, Z.H. Assay of free ferulic acid and total ferulic acid for quality assessment of *Angelica sinensis*. *J. Chromatogr. A* **2005**, *1068*, 209–219. [[CrossRef](#)]
272. Zhang, K.X.; Shen, X.; Yang, L.; Chen, Q.; Wang, N.N.; Li, Y.M.; Song, P.S.; Jiang, M.; Bai, G.; Yang, P.R.; et al. Exploring the Q-markers of *Angelica sinensis* (Oliv.) Diels of anti-platelet aggregation activity based on spectrum–effect relationships. *Biomed. Chromatogr.* **2022**, *36*, e5422. [[CrossRef](#)]

273. Hwang, H.D.; Han, J.E.; Murthy, H.N.; Kwon, H.J.; Lee, G.M.; Shin, J.H.; Park, S.Y. Establishment of bioreactor cultures for the production of chlorogenic acid and ferulic acid from adventitious roots by optimization of culture conditions in *Angelica acutiloba* (Siebold & Zucc.) Kitag. *Plant Biotechnol. Rep.* **2022**, *16*, 173–182.
274. Lim, E.Y.; Kim, J.G.; Lee, J.; Lee, C.; Shim, J.; Kim, Y.T. Analgesic effects of *Cnidium officinale* extracts on postoperative, neuropathic, and menopausal pain in rat models. *Evid. Based Complement. Alternat. Med.* **2019**, *2019*, 1–8. [[CrossRef](#)] [[PubMed](#)]
275. Qiu, G.Y.; Li, Y.; Li, X.C.; Cheng, X.L.; Wei, F.; Kang, S.; Ma, S.C. Research on chemical constituents and quality control methods of *Peucedani* medicinal materials. *Chin. Pharm. Aff.* **2019**, *33*, 446–459.
276. Yuan, C.Q. Chemical classification of Umbelliferae: Coumarins. *Foreign Med. Sci. Pharm.* **1980**, *5*, 289–294.
277. Xing, Y.C.; Li, N.; Xue, J. Progress on chemical constituents of *Ferula* genus. *J. Shenyang Pharm. Univ.* **2012**, *29*, 730–741.
278. Xie, N.; Liu, Z.R.; Zhang, M.T.; Zhang, P.; Li, D.H.; Ma, X.; Guo, Z.H.; Zheng, Q.L. Determination of 9 chemical components of coumarins in *Angelica dahurica* by high performance liquid chromatography and its multivariate statistical analysis. *PTCA (Part B Chem. Anal.)* **2022**, *58*, 659–663.
279. Fylaktakidou, K.C.; Hadjipavlou-Litina, D.J.; Litinas, K.E.; Nicolaides, D.N. Natural and synthetic coumarin derivatives with anti-inflammatory/antioxidant activities. *Curr. Pharm. Des.* **2004**, *10*, 3813–3833. [[CrossRef](#)]
280. Ngo, N.T.N.; Nguyen, V.T.; Vo, H.V.; Vang, O.; Duus, F.; Ho, T.D.H.; Pham, H.D.; Nguyen, L.H.D. Cytotoxic Coumarins from the Bark of *Mannea siamensis*. *Chem. Pharm. Bull.* **2010**, *58*, 1487–1491. [[CrossRef](#)]
281. Reddy, N.S.; Mallireddigari, M.R.; Cosenza, S.; Gumireddy, K.; Bell, S.C.; Reddy, E.P.; Reddy, M.V.R. Synthesis of new coumarin 3-(N-aryl) sulfonamides and their anticancer activity. *Bioorg. Med. Chem. Lett.* **2004**, *14*, 4093–4097. [[CrossRef](#)]
282. Sahni, T.; Sharma, S.; Verma, D.; Kaur, P. Overview of coumarins and its derivatives: Synthesis and biological activity. *Lett. Org. Chem.* **2021**, *18*, 880–902. [[CrossRef](#)]
283. Wang, S.; Shi, Y.H.; Wang, R.; Hu, S.W.; Luo, J.; Kuang, G.; Chen, S.C. Advances in chemical compositions, analytical methods and pharmacological effects of coumarins in *Peucedani* Radix. *Shanghai J. Tradit. Chin. Med.* **2022**, *56*, 89–99.
284. Ballard, C.R.; Maróstica, M.R. Chapter 10—Health Benefits of Flavonoids Health Benefits of Flavonoids. In *Bioactive Compounds*; Campos, M.R.S., Ed.; Woodhead Publishing: Cambridge, UK, 2019; pp. 185–201.
285. Gebhardt, Y.; Witte, S.; Forkmann, G.; Lukačín, R.; Matern, U.; Martens, S. Molecular evolution of flavonoid dioxygenases in the family Apiaceae. *Phytochemistry* **2005**, *66*, 1273–1284. [[CrossRef](#)] [[PubMed](#)]
286. Kim, M.R.; Lee, J.Y.; Lee, H.H.; Aryal, D.K.; Kim, Y.G.; Kim, S.K.; Woo, E.-R.; Kang, K.W. Antioxidative effects of quercetin-glycosides isolated from the flower buds of *Tussilago farfara* L. *Food Chem. Toxicol.* **2006**, *44*, 1299–1307. [[CrossRef](#)] [[PubMed](#)]
287. Zhang, T.T.; Zhou, J.S.; Wang, Q. HPLC analysis of flavonoids from the aerial parts of *Bupleurum* species. *Chin. J. Nat. Med.* **2010**, *8*, 107–113. [[CrossRef](#)]
288. Singh, M.; Kaur, M.; Silakari, O. Flavones: An important scaffold for medicinal chemistry. *Eur. J. Med. Chem.* **2014**, *84*, 206–239. [[CrossRef](#)] [[PubMed](#)]
289. Wang, Y.F.; Ma, C.Y.; Xiong, X.; Ding, Z.L. Study on antioxidative activity of total flavonoids from *Anthriscus sylvestris* in vitro and vivo. *West. J. Tradit. Chin. Med.* **2014**, *27*, 11–13.
290. Pérez-Vizcaino, F.; Ibarra, M.; Cogolludo, A.L.; Duarte, J.; Zaragoza-Arnáez, F.; Moreno, L.; López-López, G.; Tamargo, J. Endothelium-independent vasodilator effects of the flavonoid quercetin and its methylated metabolites in Rat conductance and resistance arteries. *J. Pharmacol. Exp. Ther.* **2002**, *302*, 66–72. [[CrossRef](#)]
291. Yonekura-Sakakibara, K.; Saito, K. Functional genomics for plant natural product biosynthesis. *Nat. Prod. Rep.* **2009**, *26*, 1466. [[CrossRef](#)]
292. Pan, S.L. *Bupleurum Species: Scientific Evaluation and Clinical Applications*; Taylor & Francis Group: London, UK, 2006.
293. Qin, H.Z.; Lin, S.; Deng, L.Y.; Zhu, H. Advances in pharmacological effects and mechanisms of asiaticoside. *China Pharm.* **2021**, *32*, 2683–2688.
294. Yuan, R.L.; Zhang, Y.W.; Shen, J.Y.; Wang, D.; Chen, Q.; Wang, T.; Liu, M.Y. Research progress in the effect and mechanism of medicinal plants derived terpenoids on cholestatic liver injury. *Cent. South Pharm.* **2022**, *20*, 877–887.
295. Zhou, X.; Ke, C.L.; Lv, Y.; Ren, C.H.; Lin, T.S.; Dong, F.; Mi, Y.J. Asiaticoside suppresses cell proliferation by inhibiting the NF-KB signaling pathway in colorectal cancer. *Int. J. Mol. Med.* **2020**, *46*, 1525–1537.
296. Song, P.; Na, N.; Wang, Y. Effects of saikosaponin D on insulin resistance and FoxO1/PGC-1 $\alpha$  pathway in type 2 diabetic rats. *Chin. J. Immunol.* **2022**, *11*, 1–15.
297. Li, Y.N.; Yang, S.J.; Bai, S.Y. Studies on chemical constituents from roots of *Angelica polymorpha*. *China J. Chin. Mater. Med.* **2009**, *34*, 854–857.
298. Sun, S.; Ling, X.; Kong, L.Y.; Zhang, H.Q.; He, S.A. Chromones from *Angelica morri* Hayata. *J. China Pharm. Univ.* **2003**, *34*, 125–127.
299. Xue, B.Y.; Li, W.; Li, L.; Xliao, Y.Q. A pharmacodynamic research on chromone glucosides of *Saposhnikovia divaricata*. *China J. Chin. Mater. Med.* **2000**, *25*, 297–299.
300. Shan, Y.; Feng, X.; Dong, Y.F.; Chang, Q.Y. The advance on the research of chemical constituents and pharmacological activities of *Bupleurum*. *Chin. Wild Plant Res.* **2004**, *23*, 5–7+14.
301. Li, M.F.; Li, X.Z.; Wei, J.H.; Zhang, Z.; Chen, S.J.; Liu, Z.H.; Xing, H. Selection of high altitude planting area of *Angelica sinensis* based on biomass, bioactive compounds accumulation and antioxidant capacity. *Chin. Tradit. Herb. Drugs* **2020**, *51*, 474–480.



302. Zhang, Z.M.; Zhai, Z.X.; Guo, Y.H.; Fu, X.M.; Deng, S.J.; Bu, Y.Y.; Zhao, Z.M.; Zhao, Y.H.; Yang, C.Q.; Tu, P.F.; et al. Dynamic characteristic of dry matter accumulation and isoimperatorin in *Angelica dahurica*. *Chin. Tradit. Herb. Drugs* **2005**, *36*, 902–904.
303. Yu, Y.; Wang, X.Q.; Bao, Y.X.; Zhang, Y.G.; Hou, B.S. Studies on laws of growth and development of *Bupleurum chinense*. *J. Jilin Agric. Univ.* **2003**, *25*, 523–527.
304. Zhao, J.Y.; Zhang, W.Y.; Li, Y.; Gong, J.R. Elevation effect on saikosaponin content in *Bupleurum chinense* DC taproots and lateral roots. *J. Beijing Norm. Univ. (Nat. Sci.)*. **2017**, *53*, 603–608.
305. Guo, Q.S.; Wang, C.L.; Li, Y.S.; Du, Q.; Qin, M.J. Dynamic study on dry material accumulation and amylose content of cultivated *Changium smyrnioides*. *China J. Chin. Mater. Med.* **2007**, *32*, 24–26.
306. Wang, R.H. Key points of cultivation techniques of *Angelica sinensis*. *N. Agric.* **2021**, *3*, 45–46.
307. Yan, Y.C.; Liao, W.; Li, X.L.; Guo, Q.; Chen, P. Experimental study on the main factors and planting scheme optimization in *Angelica pubescens* Maxim. cultivation. *Hubei J. Tradit. Chin. Med.* **2012**, *34*, 65–66.
308. Wei, Z.Q.; Xiao, J.Y.; Han, F. Breeding of retained species of *Angelica dahurica*. *Spec. Econ. Anim. Plant.* **2007**, *10*, 36–37.
309. Zhou, S.R.; Li, B.L. Cultivation of *Glehnia littoralis*. *Spec. Econ. Anim. Plant.* **2008**, *1*, 37–38.
310. Zhou, F.M. Wu Yiluo and new compilation of materia medica. *J. Zhejiang Chin. Med. Univ.* **1989**, *2*, 37.
311. Lee, S.H.; Lee, S.H.; Hong, C.O.; Hur, M.; Han, J.W.; Lee, W.M.; Yi, L.; Koo, S.C. Evaluation of the availability of bolting *Angelica gigas* Nakai. *Plant Resour. Soc. Korea* **2019**, *32*, 318–324.
312. Xue, Z.L. Introduction and acclimatization of wild *Libanotis buchtormensis*. *Shaanxi For. Sci. Tech.* **2011**, *3*, 95–96.
313. Li, M.F.; Kang, T.L.; Jin, L.; Wei, J.H. Research progress on bolting and flowering of *Angelica sinensis* and regulation pathways. *Chin. Tradit. Herb. Drugs* **2020**, *51*, 5894–5899.
314. Wang, C.L. Understory planting management techniques of *Anthriscus sylvestris*. *For. Prod. Spec. China* **2018**, *3*, 42–43.
315. Chen, J.; Wang, W.L.; Sun, Y.Y.; Song, J.Z. Effects of yield and quality by mowing bolting *Bupleurum chinense* from different origins. *Bull. Agric. Sci. Technol.* **2021**, *7*, 218–220.
316. Wang, C.L.; Guo, Q.S.; Cheng, B.X.; Wang, C.Y.; Zhou, Y.H. Change of chemical constituents in *Changium smyrnioides* at different ages. *China J. Chin. Mater. Med.* **2010**, *35*, 2945–2949.
317. Jiang, G.H.; Ma, Y.Y.; Hou, J.; Jia, M.R.; Ma, L.; Fan, Q.J.; Tang, L. Investigation, collection and conservation of *Ligusticum Chuanxiong* germplasm resources. *Chin. Tradit. Herb. Drugs* **2008**, *39*, 601–604.
318. Sun, P.; Tong, W.; Ye, X.; Zhang, C.; Huang, H.Y. Correlation analysis between the growth dynamics and quality of *Chuanmingshen violaceum* during the late cultivation period. *Nat. Prod. Res. Dev.* **2017**, *29*, 1154–1159.
319. Zhao, Y.H.; He, G.F.; Che, S.L. High yield cultivation technology of *Ligustium jeholense*. *Bull. Agric. Sci. Technol.* **2013**, *7*, 215–216.
320. Ou, C.G.; Mao, J.H.; Liu, L.J.; Li, C.J.; Ren, H.F.; Zhao, Z.W.; Zhuang, F.Y. Characterising genes associated with flowering time in carrot (*Daucus carota* L.) using transcriptome analysis. *Plant Biol. (Stuttg.)* **2016**, *19*, 286–297. [[CrossRef](#)]
321. Huang, Z.X.; Ceng, Y.L. Review on the technology of propagation and cultivation for *Notopterygium incisum* Ting ex H. T. Chang. *Anhui Agric. Sci. Bull.* **2018**, *24*, 45–48+50.
322. Wang, Z.W.; Zhang, Y.F.; Lu, J.; Liu, X.L.; Yang, M.H.; Chen, L. Studies on the main biological characteristics and growth and development rules of *Peucedanum praeruptum*. *China J. Chin. Mater. Med.* **2007**, *32*, 145–146.
323. Li, H.Y. Cultivation techniques for *Saposhnikovia divaricata*. *Inn. Mong. Agric. Sci. Technol.* **1995**, *34*.
324. Liu, S.L.; Xu, Y.H.; Wang, X.H.; Lei, F.J.; Wang, Y.F.; Zhang, L.X. Research progress on the early bolting and flowering of *Saposhnikovia divaricate* root. *Ginseng Res.* **2016**, *6*, 52–56.
325. Liu, X.X.; Luo, M.M.; Li, M.F.; Wei, J.H. Depicting precise temperature and duration of vernalization and inhibiting early bolting and flowering of *Angelica sinensis* by freezing storage. *Front Plant Sci.* **2022**, *13*, 853444. [[CrossRef](#)]
326. Yan, W.; Hunt, L.A. Reanalysis of vernalization data of Wheat and Carrot. *Ann. Bot.* **1999**, *84*, 615–619. [[CrossRef](#)]
327. Liu, J.H.; Guo, W.C.; Li, Y. Cultivation management, storage, and consumption of *Coriander sativum*. *Spec. Econ. Anim. Plant.* **2017**, *11*, 48–51.
328. Huang, L.Q.; Jin, L. *Suitable Technology for Production and Processing of Angelica Sinensis*; China Pharmaceutical Science and Technology Press: Beijing, China, 2018.
329. Qiu, D.Y.; Lin, H.M.; Fang, Z.S.; Li, Y.D. Effects of seedlings with different root diameters on *Angelica sinensis* early bolting and physiological changes during the medicine formation period. *Acta Prat. Sin.* **2010**, *19*, 100–105.
330. Wang, W.J. Analysis and control of early bolting characteristic of *Angelica sinensis*. *J. Northwest Univ. (Nat. Sci. Ed.)* **1977**, *7*, 32–39.
331. Yao, L. Effect of shading during the nursery of *Angelica sinensis* on bolting rate and economic characters. *Gansu Agric. Sci. Technol.* **2005**, *10*, 54–55.
332. Li, Y.D.; Liu, F.Z.; Chen, Y.; Chai, Z.X. Standardied planting technique and the main diseases and pests of Radix *Angelicae sinensis*. *Res. Prac. Chin. Med.* **2005**, *19*, 23–26.
333. Yang, F.R.; Yang, H.Y.; Guo, D.Z. Preliminary study on the early bolting of *Angelica dahurica* and prevention methods. *J. Chin. Med. Mater.* **2001**, *24*, 708.
334. Pu, S.C.; Shen, M.L.; Deng, C.F.; Zhang, W.W.; Wei, Z.Q. Effects of N, P and K rates and their proportions on curtail earlier bolting of *Angelica dahurica* var. *formosana*. *J. Southwest Univ. (Nat. Sci. Ed.)*. **2011**, *33*, 168–172.
335. Yi, S.R.; Han, F.; Huang, Y.; Wei, Z.Q.; Xiao, Z.; Quan, J.; Cao, H.Q. Study on new technology of three-stage breeding of *Angelica dahurica*. *Hunan Agric. Sci.* **2011**, *11*, 15–16.

336. Meng, X.C.; Cao, L.; Lou, Z.H. Preliminary study on investigation for bolting reason and inhibition of *Saposhnikovia Divaricata*. *Spec. Wild Econ. Anim. Plant Res.* **2004**, *4*, 18–20+23.
337. Wang, Z.H.; Zhu, J.H.; Feng, S.X.; Wang, H.W. Effects of sowing date and eradication of reed head on bolting and yield of *Saposhnikovia divaricata*. *Hubei Agric. Sci.* **2013**, *52*, 4977–4979.
338. Tong, W.S.; Huang, Q.Y.; Chang, Y. Effect of planting density on bolting, yield and effective ingredient of *S. divaricata*. *J. Northeast Agric. Univ.* **2010**, *41*, 73–77.
339. Zhang, Y.M.; Yang, J.M.; Xu, W.M.; Wang, Z.G.; Yu, H.J. Study on the skill of *Angelica acutiloba* ConHolling bolting and effect of the root. *Ginseng Res.* **2016**, *4*, 36–38.
340. Chen, X.F.; Lu, J.; Ding, D.R.; Shen, M.L.; Xie, D.M.; Li, H.F. Effect of sowing time on early bolting of *Angelica dahurica*. *China J. Chin. Mater. Med.* **1999**, *24*, 211–212.
341. Ding, D.R.; Lu, J.; Chen, X.F.; Shen, M.L.; Xie, D.M.; Li, H.F.; Ren, D.J. Effects of fertilizer types on early bolting and yield of *Angelica dahurica*. *China J. Chin. Mater. Med.* **1999**, *24*, 23–24.
342. Jiang, Y.J.; Jiang, M.Y.; Rao, F.; Huang, W.J.; Chen, C.; Wu, W. Bioinformatics analysis on the CONSTANS-like protein family in *Angelica dahurica* var. *formosana*. *Mol. Plant Breed.* **2021**, *19*, 3923–3931.
343. He, J.Z. *Preliminary Study on Premature Bolting Mechanism and the Actioity of Skin-Whitening of Angelica dahurica*; Sichuan Agricultural University: Chengdu, China, 2018.
344. Wang, W.J.; Zhang, Z.M. Bolting characteristics and control pathways of *Angelica sinensis*. *Acta Bot. Bor. Occ. Sin.* **1982**, *2*, 95–104.
345. Li, M.S. On the control bolting in the early stage of *Angelica sinensis* (Oliv.) diels. *Acta Bot. Bor. Occ. Sin.* **1983**, *3*, 70–76.
346. Lin, H.M.; Qiu, D.Y.; Chen, Y. Effect of root diameter on early bolting rate and yield in seedling of *Angelica sinensis*. *Chin. Tradit. Herb. Drugs* **2007**, *38*, 1386–1389.
347. Wang, W.J. Technology and principle of seedling frozen storage of *Angelica sinensis*. *China J. Chin. Mater. Med.* **1979**, *3*, 1–5.
348. Zhang, E.H. A study on inhibitory effect of plant growth retardants on earlier bolting of Chinese *Angelica*. *China J. Chin. Mater. Med.* **1999**, *24*, 18–20+63.
349. Li, J.; Li, M.L.; Zhu, T.T.; Zhang, X.N.; Li, M.F.; Wei, J.H. Integrated transcriptomics and metabolites at different growth stages reveals the regulation mechanism of bolting and flowering of *Angelica sinensis*. *Plant Biol. (Stuttg.)* **2021**, *23*, 574–582. [[CrossRef](#)]
350. Li, M.F.; Li, J.; Wei, J.H.; Pare, P.W. Transcriptional controls for early bolting and flowering in *Angelica sinensis*. *Plants* **2021**, *10*, 1931. [[CrossRef](#)]
351. Mao, J.H.; Mao, S.M.; Zhuang, F.Y.; Ou, C.G.; Zhao, Z.W.; Bao, S.Y. Heredity and environmental regulation of premature bolting in carrot. *Acta Agric. Bor. Sin.* **2013**, *28*, 67–72.
352. Yang, Y.G.; Zhang, H.S.; Li, Y.L.; Wang, X.W.; Yu, J.H.; Wang, X.L. Endogenous hormone content of fleshy root in relation to early bolting in summer cultivated carrot on plateau. *Acta Hortic. Sin.* **2010**, *37*, 1102–1108.
353. Chen, Y.H.; Zhang, Y.L.; Wang, Y.; Zhang, Y.P.; Wang, Y.; Li, J.Q.; Liu, X.P. Analysis and regulation of main factors affecting flower bud differentiation and bolting in carrot. *Inn. Mong. Agric. Sci. Technol.* **2002**, *6*, 45–54.
354. Zheng, C.Y.; Li, M.L.; Zhu, D.L.; Hou, L.P.; Song, H.X. Effects of sowing time in spring on the yield and quality of carrot. *J. Shanxi Agric. Sci.* **2018**, *46*, 926–927+941.
355. Wang, B.S.; Chen, Y.M.; Lian, Y.; Zhang, Y.P.; Liu, X.R.; Yu, Y. Effects of different sowing dates on early bolting and economic traits of carrots. *Vegetables* **2022**, *4*, 28–31.
356. Bao, S.Y.; Mao, J.H.; Ou, C.G.; Zhuang, F.Y.; Zhao, Z.W. Genetic analysis and OTL mapping of early bolting of *Daucus carota* L. *Acta Hortic. Sin.* **2011**, *38*, 2522.
357. Jian, Q.P.; Zheng, Y.; Zhao, R.Q.; Chen, Y.L.; Liu, Z.P.; Xian, Z.Q.; Wan, M.; Jia, F.M.; Wang, G.Q.; Huang, C. Effects of different sowing periods on early bolting and yield of *Peucedanum praeruptorum*. *J. Mt. Agric. Biol.* **2020**, *39*, 67–70.
358. Xu, G.; Li, P.M.; Yang, Y.; Luo, S.; Luo, C.; Deng, C.F. Effects of different sowing periods on early bolting, yield and quality of *Peucedanum praeruptorum*. *Mod. Agric. Sci. Technol.* **2021**, *20*, 55–57.
359. Liu, S.L.; Wang, X.H.; Gao, Y.G.; Zhao, Y.; Zhang, A.H.; Xu, Y.H.; Zhang, L.X. Transcriptomic analysis identifies differentially expressed genes (DEGs) associated with bolting and flowering in *Saposhnikovia divaricata*. *Chin. J. Nat. Med.* **2018**, *16*, 446–455. [[CrossRef](#)] [[PubMed](#)]
360. Sun, H.M. Cultivation and propagation of *Bupleurum chinense* DC. *Fore. Pharm.* **1981**, *2*, 39–40.
361. Li, M.; Zhang, Q.F.; Pu, G.B.; Liu, Y.Y.; Liu, Q.; Bu, X.; Zhang, Y.Q. Cloning and spatio-temporal expression analysis of flowering genes in *Bupleurum chinense* DC. *Acta Pharm. Sin.* **2021**, *56*, 1188–1196.
362. Chen, Y.Y.; Hu, S.Q.; Tao, S.; Yuan, C.; Xiong, M.; Peng, F.; Zhang, C. Research progress on key technology of *Ligusticum chuanxiong* cultivation. *J. Chin. Med. Mater.* **2018**, *41*, 1236–1240.
363. Zhao, H.Y. Research progress on key techniques of *Ligusticum chuanxiong* cultivation. *Farm. Consult.* **2020**, *1*, 50.
364. Song, T. *Transcriptome Sequencing and Analysis of Rhizome and Leaf in Ligusticum chuanxiong Hort*; Southwest Jiaotong University: Chengdu, China, 2015.
365. Feng, X.H.; Luo, X.G.; Wang, Y.; Li, J.; Liu, X.F. Study on the cultivation technology and field management of *Ligusticum sinenses*. *Rural Sci. Technol.* **2016**, *11*, 14–15.
366. Zhao, W.; Yang, X.; Li, J.N.; Yu, Y. Study on the influence on the vegetative character the root production and quality of *Ligusticum jeholense* by flowers buds pruning. *Chin. Wild Plant Res.* **2007**, *26*, 46–48.

367. Yin, H.F.; Jin, X.J. Effect of controlling bolting on yield and quality from root of *Notopterygium forbesii*. *J. Gansu Agric. Univ.* **2009**, *44*, 77–80.
368. Jing, R.Q.; Hu, Z.H. Effect of early bolting on the structure of medicinal parts of *Angelica sinensis*. *Acta Bot. Bor. Occ. Sin.* **1981**, *1*, 55–61.
369. Ma, Y.Y.; Zhong, S.H.; Jia, M.R.; Xiong, Y.; Jiang, G.H.; Tang, S.W. Comparison of macroscopic and microscopic characteristics of *Chuan Bai zhi* and *Gong Bai zhi*. *Lishizhen Med. Mater. Med. Res.* **2005**, *16*, 833–834.
370. Yang, Z.L.; Qian, S.m.; Scheid, R.N.; Lu, L.; Chen, X.s.; Liu, R.; Du, X.; Lv, X.c.; Boersma, M.D.; Scalf, M.; et al. EBS is a bivalent histone reader that regulates floral phase transition in *Arabidopsis*. *Nat. Genet.* **2018**, *50*, 1247–1253. [[CrossRef](#)] [[PubMed](#)]
371. Xu, L.; Wang, Y.; Dong, J.H.; Zhang, W.; Tang, M.J.; Zhang, W.L.; Wang, K.; Chen, Y.L.; Zhang, X.L.; He, Q.; et al. A chromosome-level genome assembly of radish (*Raphanus sativus* L.) reveals insights into genome adaptation and differential bolting regulation. *Plant Biotechnol. J.* **2023**, *1*, 1–15. [[CrossRef](#)]
372. Song, C.; Li, X.l.; Jia, B.; Liu, L.; Wei, P.p.; Manzoor, M.A.; Wang, F.; Li, B.Y.; Wang, G.l.; Chen, C.w.; et al. Comparative transcriptomics unveil the crucial genes involved in coumarin biosynthesis in *Peucedanum praeruptorum* Dunn. *Front Plant Sci.* **2022**, *13*, 1–14. [[CrossRef](#)] [[PubMed](#)]
373. Bohnert, H.J.; Nguyen, H.; Lewis, N.G. *Bioengineering and Molecular Biology of Plant Pathways*; Pergamon: Oxford, UK, 2008; Volume 1.

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