The Genus *Solanum*: An Ethnopharmacological, Phytochemical and Biological Properties Review

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Received: 3 January 2019 / Accepted: 27 February 2019 / Published online: 12 March 2019
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Abstract
Over the past 30 years, the genus *Solanum* has received considerable attention in chemical and biological studies. *Solanum* is the largest genus in the family Solanaceae, comprising of about 2000 species distributed in the subtropical and tropical regions of Africa, Australia, and parts of Asia, e.g., China, India and Japan. Many of them are economically significant species. Previous phytochemical investigations on *Solanum* species led to the identification of steroidal saponins, steroidal alkaloids, terpenes, flavonoids, lignans, sterols, phenolic compounds, coumarins, amongst other compounds. Many species belonging to this genus present huge range of pharmacological activities such as cytotoxicity to different tumors as breast cancer (4T1 and EMT), colorectal cancer (HCT116, HT29, and SW480), and prostate cancer (DU145) cell lines. The biological activities have been attributed to a number of steroidal saponins, steroidal alkaloids and phenols. This review features 65 phytochemically studied species of *Solanum* between 1990 and 2018, fetched from SciFinder, Pubmed, ScienceDirect, Wikipedia and Baidu, using “Solanum” and the species’ names as search terms (“all fields”).

Keywords *Solanum* · Solanaceae · Phytochemistry · Steroidal saponins and alkaloids · Ethnopharmacology

Abbreviations

| Abbreviation | Definition |
|--------------|------------|
| ABTS         | 2,2′-Azino-bis(3-ethylbenzthiazoline-6-sulphonic acid) |
| CC50         | Cytotoxic concentration of the extracts to cause death to 50% of host’s viable cells |
| CDDP         | cis-Diaminedichloroplatinum |
| DPPH         | 2,2-Diphenyl-1-picrylhydrazyl |
| EC50         | Half maximal effective concentration |
| GABA         | Neurotransmitter gamma-aminobutyric acid |
| HBV          | Hepatitis B Virus |
| HSV-1        | Herpes simplex virus type 1 |
| IC50         | Minimum inhibition concentration for inhibiting 50% of the pathogen |
| LD50         | Dose required to kill half the members of a tested population after test duration |
| MIC          | Minimum inhibitory concentration |
| MTT          | 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide |
| SAG          | Superoxide anion generation |

1 Introduction

The genus *Solanum* is considered to be one of the largest and most complex genera among the Angiosperms [1], and the most representative and largest genus of the family Solanaceae [1–4]. It is comprised of about 2000 species distributed across subtropical and tropical regions of Asia [3–9], tropical Africa [10–29], non-arid Africa [30–43], Americas [44–87], Australia [71–74, 81–84] and India [71]. The genus is well represented in Brazil with about 350 species widely distributed from north to south in diverse phytogeographic regions [70, 80]. In Brazil (Ceará, Bahia, Mato Grosso do Sul, Paraná and north-central coast of Santa Catarina State), many *Solanum* species, usually known as ‘yubeba’, the word that refers to the prickles found on the stems of several of the species, are widely used in traditional medicine [66, 80, 87]. In the northeast...
of Brazil, 80 Solanum species are distributed throughout the region and used in folk medicine. One of such species is S. capsicoides, commonly known as “Gogoia” [87]. In East Africa, several Solanum species such as S. arundo and S. incanum are known to be poisonous and are reportedly used to induce miscarriages [64].

Solanum genus is rich in economically significant species; the food crops include S. aethiopicum [20, 21], S. anguivi [30, 31] S. lycopersicum, S. melongena, S. muricatum, S. torvum and S. tuberosum [1]. Ornamental species include S. aviculare, S. capsicastrum, S. crispum, S. laciniatum, S. laxum, S. pseudocapsicum, S. rantonnetii, S. seaforthianum and S. wendlandii [1].

A series of pharmacological studies have been carried out to verify and validate the traditional medicinal applications of many plants in this genus. The studied pharmacological activities include analgesic, anthelminthic, antiallergic, anti-anemic, anti-asthmatic, antibacterial, anti-cancer, anti-convulsant, anti-depressant, anti-diabetic, anti-fungal, anti-histaminic, anti-hypertensive, anti-inflammatory, anti-malaria, anti-nociceptive, anti-psoriatic, anti-plasmodial, antiprotozoa, anti-spasmolytic, anti-tubercular, anti-vascular, antiviral, anti-worm, hepatoprotective, hypolipidemic, mosquito larvicidal, nephrotoxic, spasmylytic, schistosomicidal and vasorelaxant activities.

In the past, several reviews on Solanum genus have been documented [88–101], however, mostly with singular focus on particular species. The present review is multi faceted, and features 66 medicinal species of Solanum in their geographical distribution, traditional uses, and 670 isolated chemical constituents, including 134 steroidal saponins, 63 steroidal alkaloids, 13 pregnane glycosides, 128 terpenes, 75 flavonoids, 31 lignans, 31 other types of alkaloids, 66 sterols, 52 phenolic compounds, 20 coumarins and coumestans, 4 coumarinolignoids, 23 fatty acids and esters and 30 other compounds. Where applicable, the biological activities of compounds isolated from various species are noted.

2 Distribution and Ethnopharmacological Uses

Sixty-six species commonly used as important folk medicine, ornamental plants, or wild food sources were selected in this review, and their local names, distribution and ethnopharmacological uses were summarized in Table 1. Local names are given in different languages with which the inhabitants of a particular region use to identify a specific species. Each species’ natural habitat and/or places of cultivation are mentioned. Traditional as well as modern day applications are presented.

3 Chemical Constituents and Their Biological Properties

At least 670 compounds, including 134 steroidal saponins (1–134), 63 steroidal alkaloids (135–197), 13 pregnane glycosides (198–210), 128 terpenes (211–338), 72 flavonoids (339–413), 31 lignans (414–444), 31 other types of alkaloids (445–475), 66 sterols (476–541), 52 phenols (542–593), 20 coumarins and coumestans (594–613), 4 coumarinolignoids (614–617), 23 fatty acids and esters (618–640) and 30 other compounds (641–670) were reported from the genus Solanum. Most of them were investigated for various biological activities. The chemical constituents and their biological properties are presented in Table 2, together with their plant sources and parts, alongside the classification of structures.

3.1 Steroidal Saponins

Steroidal saponins are prominent characteristic components in Solanum species, from which 134 compounds, 1–134, have been obtained (Fig. 1). Among all the studied species, S. torvum was the one studied mostly, resulting in the isolation of 32 saponins including chlorogenone (1), (5α,25S)-spirostan-3,6-dione (2), diosgenone (3), 56–72, neochlorogenin (73), solanolactosides A–C (91–93), triterpenes J–L (95–97) and 98–102 from the leaves, fruits, aerial parts and the whole plant [323, 325, 430, 435, 436, 448, 449, 451, 452, 463].

Included herein are spirostane saponins, SC1–SC6 (35–40), isolated from the leaves of S. chrysotrichum [113–115, 117], and lyconosides Ia (46), Ib (47), II (48), III (49), and IV (50) reported from the fruits of S. lycoctonum. Indiosides G (82) and H (83) with an iso-type F ring were isolated from the medicinal extract of the whole plant of S. violaceum, together with indioside I (86), and two unusual furostanol saponins with a deformed F ring, indiosides J (87) and K (88) [391, 392]. In addition, four steroidal sapogenins, indiosides L–O (78–81) were also obtained from this plant [391]. Indioside L (78) is a rare spirostanoid possessing a 4A,4D-monoepoxide in ring A. Compounds 80 and 81 represent rare examples of spirostane with the 3β,7α-diol-5,6-ene moiety compared to the normal 3β,7β-diol-5,6-ene derivatives [391].

Two C-22 steroidal lactone saponins, namely solanolactosides A, B (91, 92) and two spirostanol glucosides, torvosides M, N (23, 8) were isolated from the extract of aerial parts of S. torvum. Compounds 91 and 92 possess the aglycon of solanolide (94), while 23 and 8 have the aglycons of yamogenin (76) and neochlorogenin (73), resp. The aglycon of 94 is an unusual C-22 steroidal lactone sapogenin [316].
Table 1 Distribution and ethnopharmacological uses of *Solanum* species

| No. | Species | Local names | Distribution | Uses |
|-----|---------|-------------|--------------|------|
| 1   | *S. abutiloides* | Dwarf tamarillo | Argentina, Bolivia [2, 3] | Ornamental, fruits edible, anti-fungal [2–4] |
| 2   | *S. aculeastrum* | Goat bitter/poison/gifa/bok-bitter-apple, thola, munulwa, umthuma, itunga, mtuma | Kenya, South Africa, Swaziland [10] | Toothache, ringworm [10], jigger wounds, gonorrhea, anti-molluscicidal [11, 12], anticancer [13–15], anti-fungal [16], antimicrobial [12, 17], anti-leishmanial [18] |
| 3   | *S. aethiopicum* | African scarlet/Ethiopian/Chinese scarlet/tomato-fruit eggplant, azoko, garden egg, gilo, golden/love apple, impwa, kumba, losuke, mock/bitter/ruffed tomato, nakasuga, nakati, ngogwe, osun, tokalu, african aubergine, aubergine amère, Ethiopian nightshade, gilo, granadillo, jilo, kumba, meloncillo de olor, meloncillo del campo, pocotillo, quillo, revienta caballo, ród aubergin, shum, silverleaf nightshade, tutia enano | China, India, Japan, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central Africa, Chad, Comoros, Congo DR, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guiner-Bissau, Ivory Coast, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Sudan, Togo, Zambia, Zimbabwe, Australia, Brazil, Italy, France [20, 21] | Fruits/leaves eaten, ornamental [20, 21], anti-ulcer, anticancer [23–26], anti-inflammatory [27] |
| 4   | *S. agrarium* | Gogóia (Brazil) | Brazil, Guyana, Venezuela [44] | Mycosis, diarrhea, gonorrhea, prostatic, inflammation, abortion [44, 45] |
| 5   | *S. americanum* | American black/white/small flower/glossy nightshade, maria pretinha (Brazil), quilete (Guatemala), popolo (Hawaii) | Tropical Pacific, Indian Ocean, Hawaii, Indochina, Brazil, Madagascar, Africa | Ripe fruit makes jams, preserved, shoots eaten, antiviral, antimicrobial [46, 47], antibacterial [48, 49], bladder spasm, joint pains, cooling, cough, gastric ulcer, protozoal infections, vermifuge [49], anticancer [47, 50–52], asthma [53] |
| 6   | *S. amygdalifolium* | | Uruguay, Argentina, Brazil | Decoration [56] |
| 7   | *S. anguivi* | Forest bitterberry, African eggplant | Non-arid Africa: Nigeria, Ghana | Leaves/fruits consumed, coughs, dysuria, nasal ulcers, asthma, toothache, cardiac disorder, worm complaints, spinal chord and nervous disorder, fever, diabetes, atherosclerosis carminative, nasal ulcers, asthma, parturition, worm expeller, itching [30–32], hypolipidemic [33, 34], anaemia [31, 32, 35], Huntington’s, Alzheimer, Parkinson, amyotrophic lateral sclerosis [36], antioxidant [33, 37–39], hypotensive [38] |
| 8   | *S. arboresum* | | Costa Rica, Colombia, Trinidad | Anti-leishmanial [60, 61], antimalarial [62] |
| 9   | *S. arundo* | | Kenya | Abortion [64], hepatoprotective [65] |
| 10  | *S. asperum* | | Brazil | Anti-molluscicidal [66], antifungal [67] |
| 11  | *S. asterophorum* | Jurubeba-de-fogo | Brazil | Liver dysfunctions, anti-diarrheal [68], spasmyloic [69] |
| 12  | *S. betaceum* | English: tree tomato, South America: tamamoro and tomate de árbol, French: arbre á tomates, tomate de la Paz, tomate en arbre. Spanish: tamarillo, tomate de árbol, tomatillo | Ecuador, Colombia, Peru, Bolivia, Rwanda, South Africa, India, Nepal China, United States, Chile, Australia, New Zealand, Malaysia, Philippines, Puerto Rico, Bhutan [71–74] | Ripe fruit edible, preservative [71, 72], antioxidant [75] |
| No. | Species            | Local names                                                                 | Distribution                                                                 | Uses                                      |
|-----|--------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|------------------------------------------|
| 13  | S. buddleifolium   | Unknown                                                                     | Brazil [79]                                                                | Unknown                                  |
| 14  | S. caavurana       | Laranjinha do mato, ‘jurubeburana’ or ‘jurubeba-branca’                   | Brazil (Ceará, Bahia, Mato Grosso do Sul, Paraná, Santa Catarina States), Paraguay, Argentina | Anemia, liver disorders, digestion [80] |
| 15  | S. capricoides     | Cockroach berry, polohauai‘i (Polynesia), devil’s apple                    | Brazil, Central America, Australia, Brooklyn, New York [81–84]             | Ornamental [83], anti-inflammatory [85], anticancer [86], anti-hypertensive [87] |
| 16  | S. cathayanum      | ‘Panacea’                                                                   | China                                                                      | Anti-inflammatory, anti-bacterial [102], anti-tumor, anti-neurodegenerative [102–106] |
| 17  | S. cernuum         | “Panaceia”                                                                  | Brazil                                                                     | Gastric ulcers, hepatic injuries, skin disorders, anti-tumor, depurative, diuretic, antimemorrhagic, antiblennorrhoea, cardiac disorders, analgesic, anti-inflammatory, urinary disorders, gastric cancer, gonorrhea [107–112] |
| 18  | S. chrysotrichum   | “Sosa”                                                                      | Mexico                                                                      | Anti-mycotic, anti-inflammatory [113–120] |
| 19  | S. cornifolium     |                                                                           | Latin America                                                              | Anti-mycotic [121]                       |
| 20  | S. crinitum        | “jurubeba” and “fruto-de-lobo”                                              | Brazil, Colombia                                                           | Anti-tumor [122, 123]                    |
| 21  | S. diphyllum       |                                                                           | Mexico, Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Florida, Texas, Indonesia, Philippines, West Indies, China, Taiwan, Egypt [124–126] | Anti-tumor [126]                        |
| 22  | S. dulcamara       | Bittersweet/bitter/European/deadly/blue climbing/woody nightshade, felonwort, violet-bloom, fallen, scarlet/snake berry, mortal, fever twig, staff vine | Northern Africa, North America, Europe, Asia                              | Skin diseases, cancers, anti-tumors, alternative, anodyne, depurative, mildly diuretic, emetic, expectorant, hepatic, mildly narcotic and purgative [127–131], skin abrasions, inflammation [132] |
| 23  | S. elaeagnifolium  | Prairie berry, Silverleaf nightshade, silverleaf/Whitehorse/half/horse nettle (English); silver-leaf bitter-apple, Satan’s bush (South Africa); trompillo (Spanish); meloncillo del campo quillo-quillo, revienta caballo (Argentine); tomatillo (Chile); trompillo (Honduras)[540] | Mexico, USA, South America, Middle East, Southern Africa, North Africa, Taiwan, Penghu Islands, Brazil, India, Germany, Kenya [539, 540] | Contraceptive, corticosteroid drugs, hepatoprotective, hypoglycemic, hepatotonic, laxative, appetizer, cardiotoxic, antispasmodic, antiepileptic, renal pain, analgesic, anti-inflammatory, anticancer, antimonialscidial [133, 134] |
| 24  | S. erianthum       | Aamourette marron (French); big eggplant, black/mullein nightshade, China flowerleaf, flame bush, tompillo, turkey berry, wild tobacco, jia yan ye shu (Chinese) | Americas, Cuba, Dominican Republic, Haiti, Jamaica, Trinidad, South America | Leukorrhea, abortion, analgesic, vertigo, dysentery, fever, diarrhea, digestive problems, anti-inflammatory, leprosy, sexually-transmitted diseases, malaria, laxative, anti-diuretic, antituberculosis B, anti-tumor [135–139] |
| 25  | S. glabratum       |                                                                           | Saudi Arabia, Yemen                                                        | Antibacteria, diuretic, scabies, syphilis, cough, hemorrhoids, anticancer [140–144] |
| 26  | S. glaucophyllum   |                                                                           | Brazil, Bolivia, Argentina, Paraguay, Uruguay                              | Anticancer [145, 146]                    |
| 27  | S. guaraniticum    | Jurubea, false-jurubeba                                                    | Brazil, Paraguay, Argentina                                                 | Anemia, fevers, crysipela, hepatitis, ulcers, uterine tumors, tonic, digestive stimulant, fevers, antioxidants [147–149] |
| No. | Species         | Local names                                                                 | Distribution                                                                 | Uses                                                                                           |
|-----|-----------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| 28  | *S. incanum*    | Thorn/bitter/sodom/poison/snake apple, mutongu (Kikuyu), mtunguja mwitu (Kiswahili), ochok (Luo) | Kenya, Uganda, Tanzania, Middle East, India, Australia, Madagascar, Mauritius, Saudi Arabia [150, 151] | Antibacterial [152, 153], antileishmanial [154], anticancer [155] conjunctivitis, inflammations [156] |
| 29  | *S. indicum*    | Poison berry, Indian nightshade, African eggplant, bush tomato, ntunfulu, bhantaki, bari kateri, kateli, kshudra bhantaki, mahati, mahotika, vartaki, vrihati, kataai kalaa, mullamkatti, papparamulli, barahantaa | India, Sri Lanka, Malaysia, China, Philippine Islands, Africa [157–159] | Diaphoretic, diuretic, expectorant, stimulant, bronchites, itching, bodyaches, asthma, wounds, toothache, narcotic, cutaneous disorders, ringworm, mouthwash [157], antinflammatory, respiratory disorders, dropsy, heart diseases, chronic fever, colic, scorpion stings, difficult urination, worm infestation [158], alopecia areata, erectile failure, boost appetite, abdominal pain, distaste, deworming, colitis [159], antitumor [160–163], ascites, edema [164] |
| 30  | *S. jabrense*   |                                                                              | Brazil [165–169] | Anticancer [168], molluscicidal [169] |
| 31  | *S. khasianum*  |                                                                              | India | Anti-inflammatory, antihelmintic, Anticancer [170–172] |
| 32  | *S. laciniatum* | Kangaroo apple                                                              | Australia, Tasmania, Wales, New Zealand [173, 174] | Unknown |
| 33  | *S. laxum*      | Potato vine, potato climber, jasmine nightshade, Natri, Tomatillo [541, 542] | Australia [175, 176], Uruguay, Argentina [177, 178] | Aphid repellant pesticide [177] |
| 34  | *S. ligustrinum*|                                                                              | Chile | Antipyretic, anti-inflammatory, fever, anti-fungal [179] |
| 35  | *S. lycarpum*   | Wolf apple, lobeina, fruit-of-wolf, jurubebao (Brazil) fruta-do-lobbo (Portuguese) [543] | Brazil | Anti-inflammatory, antihepatotoxic, hypotensive, anti-histamine [180], anticancer [181], antidiabetic [182], antischistosomal [183, 184], antileishmanicidal [185], anti-trypanosomal [186], antiprotozoal [187] |
| 36  | *S. lycopersicum*| Tomatillo (Mexico), tomate (Spanish), tomato (English)                       | Mexico, South & Central America, Asia, Africa [188] | Antimicrobial [189], antiasthma, antiatherosclerosis [190], antiplatelet [191], anticancer [190, 192] |
| 37  | *S. lyratum*    | Nipplefruit (English),                                                      | China South America [193] | Anticancer [88, 89, 194–200], anti-inflamatory [201] |
| 38  | *S. melongena*  | Aubergine, brinjal, eggplant, terong, baigan, melongene                      | India, China, Thailand, Burma, Iran, Egypt, Turkey, East Asia [202, 203] | Antioxidant [90, 91, 204–206], anticancer [206–208], antidiabetic [209], antinflammatory, analgesic, sedative, hypnotic, blood circulation [210], antimalanogenesis [211] |
| 39  | *S. muricatum*  | Melon pear, Pepino, Tree melon, sweet cucumber [544–547]                   | Equador, Colombia, Peru, Chile, Sri Lanka, New Zealand, Western Australia, Spain, Israel, Morocco, Kenya, Hawaii, California [212, 213] | Anti-inflammatory [214], antidiabetic [215], antitumor [212, 213] |
| 40  | *S. nienkui*    |                                                                              | China (Hainan) [216–218] | Unknown |
### Table 1 (continued)

| No. | Species     | Local names                                                                 | Distribution                                           | Uses                                                                 |
|-----|-------------|-----------------------------------------------------------------------------|--------------------------------------------------------|----------------------------------------------------------------------|
| 41  | S. nigrum   | Black nightshade, duscle, garden nightshade, Indian nightshade, garden huckleberry, hound’s berry, petty morel, wonder berry, small-fruited black nightshade, or popolo, makoi (Hindi), manathakkali (Tamil) | Eurasia, Americas, Austrasia, South Africa [219–221] | Mouth ulcers, peptic ulcers, dysentery, skin disorders, ringworms, painful periods, cough [219–221], anti-inflammatoriy, hepatoprotective, diuretic, antipyretic, tuberculosis, cervical carcinoma [220–222], emollient, febrifuge, narcotic, purgative, sedative, analgesic, antispasmodic, vasoconstrictor [222], antihyperlipidemic [131, 223], antimicrobial [224–226], antitumor [92–97, 227–230], antimolluscicidal [231–233], antinoceptive, antipyretic [230, 234, 235], antiallergic [236, 237], hepatoprotective, anti-inflammatory, antipyretic [98, 236, 237], CNS-depressant action [238] |
| 42  | S. nudum    | Caribbea, Haiti, Cuba [239]                                                | Caribbea, Haiti, Cuba [239]                            | Antiplasmodial [240–249]                                             |
| 43  | S. orbignianum | Brazil [250]                                                             | Brazil [250]                                           | Hypertension, vasorelaxant, antioxidant, antibiotics [251, 252]     |
| 44  | S. paludosum | Brazil                                                                     | Brazil [250]                                           | Unknown                                                              |
| 45  | S. paniculatum | Jurubeba, jubeba, juribeba, juripeba, jupela, juripeba, juuma, juvena, jurubeinha, jurube-banca, jurubea-verdadeira | Brazil, Argentina, Paraguay, southern, central, eastern and northern Brazil [253–255] | Anemia, anorexia, bile insufficiency, bladder problems, blood cleansing, bleeding, boils, catarrh, congestion, contusions, constipation, convalescence, cystitis, debility, diabetes, digestive sluggishness, dyspepsia, edema, erysipelas, fever, flatulence, gallbladder inflammation, gastric disorders, hangover, headache, heartburn, hepatitis, hives, irritable bowel syndrome, itch, jaundice, liver problems, malaria, menstrual disorders, nausea, skin disorders, spleen inflammation, tumors, ulcers, water retention, wounds [253–255], antiherpes [256], antitumor [257, 258], antifungal [259, 260], antibacterial [260] |
| 46  | S. pseudocapsicum | Jerusalem/winter cherry, Madeira,                                         | South Africa, Australia, New Zealand, Peru, Ecuador [261–263] | Hepatoprotective [264]                                               |
| 47  | S. rostratum | Buffalobur/spiny nightshade, Colorado bur, Kansas/Mexican/Texas thistle   | United States, northern and central Mexico [265–272]  | Cardiovascular [273]                                                 |
| 48  | S. sarachoides | Hairy/leafy-fruited nightshade                                            | Columbia [274, 275]                                    | Unknown                                                              |
| 49  | S. schimperianum | Somali, Eritrea, Ethiopia, Egypt, Yemen [276]                            | Somali, Eritrea, Ethiopia, Egypt, Yemen [276]          | Antimicrobial [277, 278], antifungal [279]                            |
| 50  | S. septemlobum | Qing qi (Chinese)                                                        | China (Anhui, Gansu, Hebei, Henan, Jiangsu, Liaoning, Nei Mongol, Shandong, Shanxi, Sichuan, Xinjiang, East Xizang, Zhejiang) [280, 281] | Antipyretic, antidotal [261], anticancer [261, 262]                  |
| 51  | S. sessiliflorum | Cocona                                                                     | Peru, Colombia, Venezuela [282–284, 549], Bolivia, Mexico [282–284, 549] | Antioxidant [550], antimicrobial, hypolipidemic [285]               |
| 52  | S. sisymbriifolium | Vila-vila, sticky nightshade, red buffalo bur, fire and ice, litchi tomato, morelle de balbis | Brazil, Argentina, Uruguay, Paraguay [286–288] | Cardiovascular [289], antidiarrheal [289], hypotensive [291, 292], antimicrobial, antioxidant [293], anticonvulsant, CNS depressant [294], antimolluscicidal [295], analgesic [290, 296] |
| No. | Species | Local names | Distribution | Uses |
|-----|---------|-------------|--------------|------|
| 53  | *S. spirale* | Cockroach/yellow berry; thorn gourd/eggplant; belladonna; Night-shade, Febrifuge plant (English); Choti kateri/Bhatakaiyya, Rengani (Hindi); | Southern China, India, Bangladesh, Thailand, Laos, Philippines, Australia | Anaesthetic, diuretic and narcotic, antibacterial, anticancer [297–299] |
| 54  | *S. surattense* | China [300, 301], India [302] | Anti-inflammatory, antibacterial, antitumor, antioxidant, anti-platelet aggregation [301–302], diuretic [303], antiplasmodial [304], antiinflammatory, antioxidant, antihypertensive [99] |
| 55  | *S. torvum* | Brazil, Colombia, Caribbean, Central America, Mexico, tropical Africa, Asia, Australia, Hawaii, Guam, American Samoa | Antibacterial, anti-platelet aggregation [100, 313], pesticide [314], analgesic [314], anticancer [315–317], antifungal, antimicrobial [318–320], antiinfectious [321], antiviral [322], anticonvulsant [323], antihypertensive [324, 325, 553], antinfectious [326, 327], antioxidants [328–330], anti-inflammatory [331], antidepressant [332, 333], antilipid [334], antidiabetic [335–337], antihypertensive [338] |
| 56  | *S. tridynamum* | Spanish: mala mujer, sacamanteca, ojo de liebre, berenjena Silvestre | Mexico [339, 340] | Antidiabetic [339–341] |
| 57  | *S. trilobatum* | Purple fruited pea eggplant, Thai nightshade | India, Myanmar, Thailand, Vietnam, Malaysia | Antifungal, antimicrobial, asthma, vomiting, rheumatism, leprosy [342–343], fever, antioxidant [344], antibacterial [345–347], antidiabetic [348], anticancer [349–355], mosquitocidal [356, 357], antiinfectious [358], antioxidant [359], antileishmanial [360] |
| 58  | *S. triste* | Venezuela, Trinidad, Martinique, Dominica | Unknown |
| 59  | *S. tuberosum* | Potato | Chile, Peru, Bolivia [101, 362, 363] | Antifungal, antimicrobial [364], antioxidants [365, 366], antileishmanial [367, 368], anticancer [369–372], antihypertensive [373] |
| 60  | *S. umbelliferum* | Bluewitch nightshade | California, Arizona [374–379] | Unknown |
| 61  | *S. uporo* | Cannibal’s tomato | Fiji island, Tonga, Samoa, Tuamotus, Hawaii [381–384] | Anticancer [380] |
| 62  | *S. validinervium* | Venezuela [385] | Unknown |
| 63  | *S. vestissimum* | Toronjo, tumbo/coquina melon, lulo fruit | Colombia, Venezuela [386, 387] | Unknown |
| 64  | *S. violaceum* | Hairy nightshade, wholly nightshade, red nightshade | Europe, western Asia, northern Africa, North America, Australia, India | Antimolluscicidal [554], mosquitocidal [388, 389, 555] |
| 65  | *S. violaceum* | China, India, Myanmar, Thailand, Cambodia, Laos, Vietnam, Malaysia, Indonesia, Philippines | Anticancer, anti-inflammatory, antimicrobial, antioxidant, antihypertensive [390–393] |
| No. | Species | Local names | Distribution                                                                 | Uses                                                                                                                                 |
|-----|---------|-------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| 66  | *S. xanthocarpum* | Wild eggplant, Kantakari, yellow berried nightshade, huang shui qi (Chinese) | Nepal, Pakistan, Bhutan, Bangladesh, Myanmar, Sri Lanka, China, Iran, Yemen, Thailand, Afghanistan, Saudi Arabia, India | Anthelmintic, anti-inflammatory, anodyne, digestive, carminative, appetizer, stomachic, depurative, sudorific, febrifuge, expectorant, laxative, diuretic, emmenagogue, aphrodisiac, leishmaniasis, immunomodulatory, anti-asthmatic [394–400], antimicrobial [226, 401–405], molluscicidal, hepatoprotective, antidiabetic [406–413] antioxidant, antinociceptive, nephroprotective, mosquitocidal, anti-psoriatic, diuretic, antiurolithic [414–429] |
Table 2  Phytochemistry, biological properties and classification of *Solanum* compounds

| No. | Compounds                        | Plant sources | Parts          | Biological properties        | References |
|-----|----------------------------------|---------------|----------------|----------------------------|------------|
| 1   | Chlorogenone                     | *S. torvum*   | Fruit          |                            | [430]      |
| 2   | (5α,25S)-Spirostan-3,6-dione     | *S. torvum*   | Fruit          |                            | [430]      |
| 3   | Solakhasoside                    | *S. khasianum*| Fruit          |                            | [431]      |
| 4   | Foiliumin                        | *S. amygdalifolium* | Aerial         |                            | [57]       |
| 5   | Foiliumin A                      | *S. amygdalifolium* | Aerial         |                            | [56]       |
| 6   | Neotigogenin                     | *S. paniculatum* | Leaf           | Cytotoxic                  | [257]      |
| 7   | Diuranthoside A                  | *S. cathayanum* | Root           |                            | [432]      |
| 8   | Torvoside N                      | *S. torvum*   | Aerial         | Anticancer                 | [316]      |
| 9   | Atroposide E                     | *S. dulcamara* | Aerial         |                            | [433]      |
| 10  | Degalactotigogenin               | *S. pulchellum* | Aerial         |                            | [433]      |
| 11  | Trillin                          | *S. paniculatum* | Aerial         |                            | [258]      |
| 12  | Diosgenin gentiobioside          | *S. paniculatum* | Aerial         |                            | [258]      |
| 13  | Diosgenone                       | *S. nudum*    | Leaf           | Hepatoprotective           | [242, 247, 249] |
| 14  | (22R, 23S, 25R)-3β, 6α, 23-trihydroxy-5α-spirostan-6-O-β-D-xylosyl-(1″-3″)-O-[β-D-glucopyranosyl(1″-2″)]-O-[α-L-rhamnopyranosyl(1″-3″)]-O-β-D-glucopyranoside | *S. paniculatum* | Aerial         |                            | [258]      |
| 15  | Nuatigenosido                    | *S. sisymbriifolium* | Root           | Antihypertensive           | [289, 291] |
| 16  | (3β, 5α, 14β, 25R)-3-Hydroxy-6-one | *S. villosum* | Leaf           |                            | [434]      |
| 17  | (3β, 5α, 6α, 25S)-3-Hydroxy-6-deoxy-6-O(6-deoxy-α-L-rhamnopyranosyl) -β-D-glucoside | *S. torvum* | Whole          |                            | [435]      |
| 18  | Torvoside Q                      | *S. torvum*   | Aerial         |                            | [331, 436] |
| 19  | Dioscin                          | *S. indicum*  | Fruit          | Antimelanogenesis          | [211]      |
|     |                                  | *S. melongena* | Fruit          |                            | [437]      |
|     |                                  | *S. rostratum* | Aerial         |                            | [437]      |
| 20  | Prosapogenin A                   | *S. indicum*  | Fruit          |                            | [160]      |
| 21  | Diosgenin                        | *S. lycopersicum* | Aerial         |                            | [438]      |
|     |                                  | *S. melongena* | Aerial         |                            | [439]      |
|     |                                  | *S. nigrum*   | Fruit          |                            | [440]      |
|     |                                  | *S. torvum*   | Fruit          |                            | [430]      |
|     |                                  | *S. tridynamum* | Root           |                            | [341]      |
|     |                                  | *S. tuberosum* | Stem           |                            | [441]      |
|     |                                  | *S. violaceum* | Aerial         |                            | [391, 442] |
| 22  | Aspidistrin                      | *S. cathayanum* | Root           |                            | [432]      |
| 23  | Torvoside M                      | *S. torvum*   | Aerial         | Anticancer                 | [316]      |
| 24  | Protodioscin                     | *S. abutiloides* | Root           |                            | [7]        |
|     |                                  | *S. incanum*  | Root           |                            | [156]      |
|     |                                  | *S. indicum*  | Fruit          |                            | [160, 443] |
|     |                                  | *S. spirale*  | Fruit          |                            | [444]      |
| 25  | Methylprotodioscin               | *S. incanum*  | Root           |                            | [155]      |
|     |                                  | *S. indicum*  | Fruit          |                            | [160]      |
| 26  | Indioside D                      | *S. incanum*  | Root           |                            | [156]      |
| 27  | 26-O-β-D-Glucosyl-22-methoxyfurost-5-ene-3β, 26-diol 3-O-α-L-rhamnopyranosyl(1-2)-β-D-glucoside | *S. indicum* | Fruit          |                            | [160]      |
|     |                                  | *S. spirale*  | Fruit          |                            | [444]      |
| 28  | (3β, 22α, 25R)-26-(β-D-Glucosylxylo)-22-hydroxyfurost-5-en-3-yl O-β-D-glucosyl-(1-2)-O-β-D-glucosyl-(1-4)-β-D-glucoside | *S. cathayanum* | Root           |                            | [432]      |
| No. | Compounds                                                                 | Plant sources     | Parts       | Biological properties   | References |
|-----|---------------------------------------------------------------------------|-------------------|-------------|-------------------------|------------|
| 29  | 25R-Timososaponin H1                                                      | S. cathayanum     | Root        |                         | [432]      |
| 30  | Torvoside O                                                               | S. torvum         | Leaf        |                         | [445]      |
| 31  | (23S,25R)-spirost-5-en-3,23 diol 3-O-α-l-rhamnosyl-(1-2)-O-α-l-rhamnosyl-1-4β-D-glucoside | S. glabratum      | Aerial      |                         | [141]      |
| 32  | 23-β-D-glucosyl (23S,25R)spirost-5-en-3,23 diol 3-O-α-l-rhamnosyl-1-2O-α-l-rhamnosyl-(1-4)β-D-glucoside | S. glabratum      | Aerial      |                         | [141]      |
| 33  | (25R)spirost-5-en-3-ol 3-O-α-l-rhamnosyl-1-2)O-β-D-glucosyl-1-3)β-D-galactoside | S. glabratum      | Aerial      |                         | [141]      |
| 34  | Isonuigenin-3-O-β-solatriose                                             | S. sisymbriifolium | Root        |                         | [446]      |
| 35  | Saponin SC-1                                                             | S. chrysotrichum  | Leaf        |                         | [118]      |
| 36  | Saponin SC-2                                                             | S. chrysotrichum  | Leaf        | Antifungal              | [113–115, 117] |
| 37  | Saponin SC-3                                                             | S. chrysotrichum  | Leaf        | Antifungal              | [114, 117] |
| 38  | Saponin SC-4                                                             | S. chrysotrichum  | Leaf        | Antifungal              | [114, 117] |
| 39  | Saponin SC-5                                                             | S. chrysotrichum  | Leaf        | Antifungal              | [114, 117] |
| 40  | Saponin SC-6                                                             | S. chrysotrichum  | Leaf        | Antifungal              | [114, 117] |
| 41  | Chlorogenin                                                              | S. chrysotrichum  | Leaf        |                         | [117]      |
|     |                                                                            | S. tridynamum     | Root        |                         | [341]      |
|     |                                                                            | S. torvum         | Fruit       |                         | [430]      |
| 42  | Chrysogenin                                                              | S. chrysotrichum  | Leaf        |                         | [117]      |
| 43  | Luxumin A                                                                 | S. laxum          | Aerial      |                         | [178]      |
| 44  | Luxumin B                                                                 | S. laxum          | Aerial      |                         | [178]      |
| 45  | Luciamin                                                                  | S. laxum          | Aerial      |                         | [177]      |
| 46  | Lyconoside Ia                                                            | S. lycocarpum     | Fruit       |                         | [447]      |
| 47  | Lyconoside Ib                                                            | S. lycocarpum     | Fruit       |                         | [447]      |
| 48  | Lyconoside II                                                             | S. lycocarpum     | Fruit       |                         | [447]      |
| 49  | Lyconoside III                                                            | S. lycocarpum     | Fruit       |                         | [447]      |
| 50  | Lyconoside IV                                                             | S. lycocarpum     | Fruit       |                         | [447]      |
| 51  | 26-O-(β-D-Glucosyl) nuatigenin-3-O-α-l-rhamnosyl-(1-4)-β-D-glucoside      | S. surattense     | Aerial      |                         | [305]      |
| 52  | Aculeatiside A                                                            | S. surattense     | Aerial      |                         | [305]      |
| 53  | (22R, 23S, 25R)-3β,6α,23-trihydroxy-5α-spirostan-6-O-β-D-xylosyl-1-3)-β-D-quinovoside | S. surattense     | Aerial      |                         | [305]      |
| 54  | (22R,23S,25S)-3β,6α,23-trihydroxy-5α-spirostan-6-O-β-D-xylosyl-1-3)-O-β-D-quinovoside | S. surattense     | Aerial      |                         | [305]      |
| 55  | (22R,23R,25S)-3β,6α,23-trihydroxy-5α-spirostan-6-O-β-D-xylosyl-1-3)-O-β-D-quinovoside | S. surattense     | Aerial      |                         | [305]      |
| 56  | Neochlorogenin 6-O-β-D-quinovoside                                        | S. torvum         | Aerial      |                         | [331, 448] |
| 57  | Neochlorogenin 6-O-β-D-xylosyl (1-(3)-β-D-quinovoside                      | S. torvum         | Aerial      | Anti-inflammatory       | [331, 448] |
| 58  | Neochlorogenin 6-O-α-l-rhamnosyl-(1-3)-β-D-quinovoside                    | S. torvum         | Aerial      |                         | [448, 449] |
| 59  | Solagenin 6-O-β-D-quinovoside                                             | S. torvum         | Whole       |                         | [448–450]  |
| 60  | Solagenin 6-O-α-l-rhamnosyl-(1-3)-β-D-quinovoside                         | S. torvum         | Whole       |                         | [448]      |
| 61  | (25S)26-β-D-glucosyloxy)3-oxo-5α-furost-20(22)en-6α-yl-O-β-D-xyloside     | S. torvum         | Fruit       |                         | [451]      |
| No. | Compounds                                                                 | Plant sources   | Parts     | Biological properties          | References |
|-----|---------------------------------------------------------------------------|-----------------|-----------|--------------------------------|------------|
| 62  | (25S) (26β-β-D-glucosyloxy)3-oxo-22α-methoxy-5α-furostan-6α-yl-O-β-D-xyloside | S. torvum       | Fruit     |                                | [451]      |
| 63  | (25S) (26β-β-D-glucosyloxy)3β-hydroxy-22α-methoxy-5α-furostan-6α-yl-O-α-L-rhamnopyranosyl-1-3β-β-D-xyloside | S. torvum       | Fruit     |                                | [451]      |
| 64  | Torvoside A                                                               | S. torvum       | Aerial    |                                | [313, 449] |
| 65  | Torvoside B                                                               | S. torvum       | Root      |                                | [449]      |
| 66  | Torvoside E                                                               | S. torvum       | Root      |                                | [449]      |
| 67  | Torvoside F                                                               | S. torvum       | Root      |                                | [449]      |
| 68  | Torvoside H                                                               | S. torvum       | Fruit     |                                | [313]      |
| 69  | (25S) (26β-β-D-glucosyloxy)3-oxo-22α-methoxy-5α-furostan-6α-yl-O-β-D-xyloside | S. torvum       | Fruit     |                                | [451]      |
| 70  | (25S) (3-oxo-5α-spirostan-6α-yl-O-β-D-xyloside)                           | S. tridynamum   | Root      |                                | [313, 449] |
| 71  | (25S) (3β-hydroxy-5α-spirostan-6α-yl-O-β-D-xyloside)                      | S. violaceum    | Aerial    |                                | [391]      |
| 72  | (25S) (3β,27-dihydroxy-5α-spirostan-6α-yl-O-β-D-xyloside)                 | S. violaceum    | Whole     |                                | [392]      |
| 73  | Neochlorogenin                                                            | S. tridynamum   | Root      |                                | [451]      |
| 74  | Tigogenin                                                                 | S. americacun    | Leaf      |                                | [54]       |
| 75  | Yuccagenin                                                                | S. tridynamum   | Root      |                                | [341]      |
| 76  | Yamogenin                                                                 | S. violaceum    | Aerial    |                                | [391]      |
| 77  | Yamogenone                                                                | S. violaceum    | Aerial    |                                | [391]      |
| 78  | Indioside L                                                               | S. violaceum    | Aerial    |                                | [391]      |
| 79  | Indioside M                                                               | S. violaceum    | Aerial    |                                | [391]      |
| 80  | Indioside N                                                               | S. violaceum    | Aerial    |                                | [391]      |
| 81  | Indioside O                                                               | S. violaceum    | Aerial    |                                | [391]      |
| 82  | Indioside G                                                               | S. violaceum    | Whole     |                                | [392]      |
| 83  | Indioside H                                                               | S. violaceum    | Whole     | Anticancer                     | [392]      |
| 84  | Borassoside D                                                             | S. violaceum    | Whole     |                                | [392]      |
| 85  | Borassoside E                                                             | S. violaceum    | Whole     | Anticancer, anti-inflammatory  | [392]      |
| 86  | Indioside I                                                               | S. violaceum    | Whole     | Anticancer, anti-inflammatory  | [392]      |
| 87  | Indioside J                                                               | S. violaceum    | Whole     |                                | [392]      |
| 88  | Indioside K                                                               | S. violaceum    | Whole     |                                | [392]      |
| 89  | Yamoscin                                                                  | S. violaceum    | Whole     | Anticancer                     | [331]      |
| 90  | Zingiberoside A1                                                          | S. violaceum    | Whole     |                                | [392]      |
| 91  | Solanolactoside A                                                         | S. torvum       | Aerial    |                                | [316]      |
| 92  | Solanolactoside B                                                         | S. torvum       | Aerial    |                                | [316]      |
| 93  | Solanolactoside C                                                         | S. torvum       | Aerial    |                                | [436]      |
| 94  | Solanolide                                                                | S. torvum       | Aerial    |                                | [316]      |
| 95  | Torvoside J                                                               | S. surattense    | Aerial    | Anticonvulsant                 | [305]      |
| 96  | Torvoside K                                                               | S. surattense    | Aerial    | Anticonvulsant, antifungal     | [305]      |

Table 2 (continued)
Table 2 (continued)

| No. | Compounds                                                                 | Plant sources | Parts     | Biological properties             | References |
|-----|---------------------------------------------------------------------------|---------------|-----------|-----------------------------------|------------|
| 97  | Torvoside L                                                               | *S. surattense* | Aerial    | Anticonvulsant                    | [305]      |
|     |                                                                           | *S. torvum*   | Aerial    |                                   | [323, 331, 435, 452] |
|     |                                                                           | *S. paniculatum* | Leaf     |                                   | [260]      |
| 98  | (22R,23S,25S)-3β,6α,23-trihydroxy-5α-spirostan-6-O-β-D-xylosyl-(1-3)O-β-D-quinovoside | *S. torvum*   | Aerial    |                                   | [323, 331] |
| 99  | (22R,23S,25R)-3β,6α,23-trihydroxy-5α-spirostan-6-O-β-D-xylosyl-(1-3)O-β-D-quinovoside | *S. torvum*   | Aerial    | Anti-inflammatory                  | [331]      |
| 100 | (22R,23R,25S)-3β,6α,23-trihydroxy-5α-spirostan-6-O-β-D-xylosyl-(1-3)O-β-D-quinovoside | *S. torvum*   | Aerial    | Anti-inflammatory                  | [331]      |
| 101 | Gekogenin                                                                 | *S. torvum*   | Fruit     |                                   | [430]      |
| 102 | Sisalagenin                                                               | *S. torvum*   | Fruit     |                                   | [430]      |
| 103 | Δ25(27)stigogenin-3-O-β-D-glucoside                                       | *S. paniculatum* | Leaf     | Antiviral                         | [257]      |
| 104 | Soladulcosides A                                                          | *S. dulcamara* | Aerial    |                                   | [129]      |
| 105 | Soladulcosides B                                                          | *S. dulcamara* | Aerial    |                                   | [129]      |
| 106 | Abutiloside L                                                             | *S. abutiloides* | Root     |                                   | [4]        |
| 107 | Abutiloside M                                                             | *S. abutiloides* | Root     |                                   | [4]        |
| 108 | Abutiloside N                                                             | *S. abutiloides* | Root     |                                   | [4]        |
| 109 | Abutiloside O                                                             | *S. abutiloides* | Root     |                                   | [4]        |
| 110 | Torvoside C                                                               | *S. torvum*   | Root      |                                   | [449]      |
| 111 | Torvoside D                                                               | *S. surattense* | Aerial    |                                   | [305]      |
|     |                                                                           | *S. torvum*   | Root      |                                   | [331, 449] |
| 112 | Torvoside G                                                               | *S. torvum*   | Fruit, Root |                                   | [313, 449] |
| 113 | Torvoside P                                                               | *S. torvum*   | Leaf      |                                   | [445]      |
| 114 | Anguivioside A                                                            | *S. anguivi*  | Fruit     |                                   | [41]       |
| 115 | Anguivioside B                                                            | *S. anguivi*  | Fruit     |                                   | [41]       |
| 116 | Anguivioside C                                                            | *S. anguivi*  | Fruit     |                                   | [41]       |
| 117 | Anguivioside I                                                            | *S. indicum*  | Fruit     |                                   | [443]      |
| 118 | Anguivioside III                                                           | *S. anguivi*  | Fruit     |                                   | [43]       |
|     |                                                                           | *S. indicum*  | Fruit     |                                   | [443]      |
| 119 | Anguivioside XI                                                           | *S. anguivi*  | Fruit     |                                   | [43]       |
| 120 | Anguivioside XV                                                            | *S. anguivi*  | Fruit     |                                   | [43]       |
| 121 | Anguivioside XVI                                                           | *S. anguivi*  | Fruit     |                                   | [43]       |
| 122 | Inunigroside A                                                            | *S. nigrum*   | Fruit     |                                   | [453]      |
| 123 | 25(S)-26-O-β-D-xylosyl-5α-furost-22(20)-en-3β,6α,26-triol 6-O-[α-L-      | *S. torvum*   | Fruit    | Anticancer                        | [317]      |
|     |    rhamnosyl-(1-3)-O-β-D-quinovoside|                                                                     |           |                                   |            |
| 124 | 25(S)-26-O-β-D-xylosyl-5α-furost-22(20)-en-3-one-6α,26-diol 6-O-[α-L-     | *S. torvum*   | Fruit    | Anticancer                        | [317]      |
|     |    rhamnosyl-(1-3)-O-β-D-quinovoside|                                                                     |           |                                   |            |
| 125 | 25(S)-26-O-β-D-xylosyl-5α-furost-22(20)-en-3β,6α,26-triol 6-O-β-D-         | *S. torvum*   | Fruit    | Anticancer                        | [317]      |
|     |    quinovoside                                                             |                                                                     |           |                                   |            |
| 126 | Paniculonin B                                                             | *S. torvum*   | Leaf      |                                   | [323]      |
| 127 | Smilaxchinoside A                                                          | *S. rostratum* | Aerial    |                                   | [437]      |
| 128 | 6-O-α-L-rhamnosyl-(1″-3″)-β-D-quinovosyl-(22S,23R,25S)-3β,6α,23-     | *S. paniculatum* | Leaf    |                                   | [260]      |
|     |    trihydroxy-5α-spirostan-6-O-β-D-xylosyl-(1-3)-O-β-D-quinovoside        |                                                                     |           |                                   |            |
Table 2 (continued)

| No. | Compounds                                                                 | Plant sources | Parts       | Biological properties                                      | References |
|-----|---------------------------------------------------------------------------|---------------|-------------|------------------------------------------------------------|------------|
| 129 | 6-O-β-D-Xylosyl-(1″-3′)-β-D-quinovosyl-(23R,25S)-3β,6α,23-trihydroxy-5α-   | S. paniculatum| Leaf        |                                                            | [260]      |
|     |   spirostane                                                             |               |             |                                                            |            |
| 130 | 6-O-β-D-Xylosyl-(1″-3′)-β-D-quinovosyl-(22S,23S,25R)-3β,6α,23-trihydroxy-5α- | S. paniculatum| Leaf        |                                                            | [260]      |
|     |   spirostane                                                             |               |             |                                                            |            |
| 131 | 3-O-α-L-Rhamnosyl-(1″-3′)-β-D-quinovosyl-(22S,23S,25R)-3β,6α,23-trihydroxy-5α- | S. paniculatum| Leaf        |                                                            | [260]      |
|     |   spirostane                                                             |               |             |                                                            |            |
| 132 | 3-O-β-D-Xylosyl-(1″-3′)-β-D-quinovosyl-(22S,23S,25R)-3β,6α,23-trihydroxy-5α- | S. paniculatum| Leaf        |                                                            | [260]      |
|     |   spirostane                                                             |               |             |                                                            |            |
| 133 | 6-O-α-L-Rhamnosyl-(1″-3′)-β-D-quinovosyl-(22S,25S)-1β,3β,6α-trihydroxy-5α- | S. paniculatum| Leaf        |                                                            | [260]      |
|     |   spirostane                                                             |               |             |                                                            |            |
| 134 | 6-O-β-D-Xylosyl-(1″-3′)-β-D-quinovosyl-(22S,25S)-3β,4β,6α-trihydroxy-5α-    | S. paniculatum| Leaf        |                                                            | [260]      |
|     |   spirostane                                                             |               |             |                                                            |            |
|     | Steroidal alkaloids                                                      |               |             |                                                            |            |
| 135 | Demissine                                                                | S. tuberosum  | Stem        |                                                            | [101]      |
| 136 | Solasodiene                                                              | S. torvum     | Fruit       |                                                            | [430]      |
| 137 | Solanositide A                                                           | S. surattense | Whole       |                                                            | [454]      |
| 138 | Solanositide B                                                           | S. surattense | Whole       |                                                            | [454]      |
| 139 | Solamargine                                                              | S. abutiloides| Root        |                                                            | [7]        |
|     |                                                                          | S. aculeastrum| Fruit       |                                                            | [19]       |
|     |                                                                          | S. asperum    | Root        |                                                            | [66, 67]   |
|     |                                                                          | S. buddleifolium| Stem      |                                                            | [79]       |
|     |                                                                          | S. americanum | Fruit       |                                                            | [55]       |
|     |                                                                          | S. anguivi    | Root        |                                                            | [42]       |
|     |                                                                          | S. crinitum   | Fruit       |                                                            | [122]      |
|     |                                                                          | S. erianthum  | Leaf        |                                                            | [137, 455] |
|     |                                                                          | S. incanum    | Root        |                                                            | [156]      |
|     |                                                                          | S. khasianum  | Fruit       |                                                            | [456]      |
|     |                                                                          | S. lycocarpum | Fruit       | Leishmanicidal, antidiabetic, schistosomicidal, trypanocidal | [182, 183, 185, 186, 447, 457] |
|     |                                                                          | S. melongena  | Fruit, Root |                                                            |            |
| 140 | γ-Solamargine                                                            | S. nigrum     | Whole       |                                                            | [228]      |
|     |                                                                          | S. paludosum  | Fruit       |                                                            | [253]      |
|     |                                                                          | S. sarrachoides| Leaf       | Anticancer                                                | [458]      |
|     |                                                                          | S. surattense | Aerial      |                                                            | [305]      |
| 141 | Khasianine                                                               | S. xanthocarpum| Fruit      | Antibacterial, molluscidal                                 | [384]      |
|     |                                                                          | S. xanthocarpum| Fruit      |                                                            | [403, 406] |
|     |                                                                          | S. umbelliferum| Whole      |                                                            | [380]      |
| No. | Compounds               | Plant sources         | Parts    | Biological properties                              | References                        |
|-----|-------------------------|-----------------------|----------|---------------------------------------------------|-----------------------------------|
| 142 | Solasonine              | *S. americanum*       | Leaf     |                                                   | [54]                              |
|     |                         | *S. amygdalifolium*   | Aerial   |                                                   |                                   |
|     |                         | *S. asperum*          | Fruit    |                                                   | [66, 67]                          |
|     |                         | *S. crinitum*         | Aerial   |                                                   | [122, 123, 459]                   |
|     |                         | *S. erianthum*        | Leaf     |                                                   | [137, 455]                        |
|     |                         | *S. khasianum*        | Fruit    |                                                   | [456]                             |
|     |                         | *S. lycocarpum*       | Fruit    | Leishmanicidal, antidiabetic, schistosomicidal    | [182, 183, 185, 447, 457]         |
|     |                         | *S. melongena*        | Fruit, Root |                                                   | [206, 439]                        |
|     |                         | *S. sarrachoides*     | Leaf     |                                                   | [458]                             |
|     |                         | *S. sessiliflorum*    | Fruit    |                                                   | [460]                             |
|     |                         | *S. sisymbriifolium*  | Fruit    |                                                   | [294]                             |
| 143 | β1-Solasonine           | *S. nigrum*           | Whole    |                                                   | [228]                             |
| 144 | 12-Hydroxysolasonine    | *S. lycocarpum*       | Fruit    |                                                   | [182, 447]                        |
| 145 | Solasodine              | *S. americanum*       | Leaf     |                                                   | [54]                              |
|     |                         | *S. aculeastrum*      | Fruit    | Anticancer                                        | [13]                              |
|     |                         | *S. crinitum*         | Aerial   |                                                   | [123]                             |
|     |                         | *S. khasianum*        | Fruit    |                                                   | [172, 456]                        |
|     |                         | *S. laciniatum*       | Aerial   |                                                   | [461, 462]                        |
|     |                         | *S. lycocarpum*       | Fruit    |                                                   | [185]                             |
|     |                         | *S. melongena*        | Fruit    |                                                   | [206]                             |
|     |                         | *S. nigrum*           | Whole    |                                                   | [163, 440]                        |
|     |                         | *S. sisymbriifolium*  | Fruit    |                                                   | [294]                             |
|     |                         | *S. surattense*       | Whole    | CNS depressant                                    | [303]                             |
|     |                         | *S. torvum*           | Whole    | Anti-inflammatory                                  | [463]                             |
|     |                         | *S. trilobatum*       | Whole    |                                                   | [358]                             |
|     |                         | *S. villosum*         | Whole    |                                                   | [442]                             |
|     |                         | *S. xanthocarpum*     | Fruit    | Antibacterial                                      | [403, 429]                        |
| 146 | N-Hydroxysolasodine     | *S. paludosum*        | Root     |                                                   | [464]                             |
| 147 | O-Acetylolasodine       | *S. umbelliferum*     | Whole    |                                                   | [380]                             |
| 148 | Putuline                | *S. paludosum*        | Root     |                                                   | [464]                             |
| 149 | Anguivine               | *S. anguivi*          | Root     |                                                   | [42]                              |
|     |                         | *S. uporo*            | Root     |                                                   | [384]                             |
| 150 | Isoanguivine            | *S. uporo*            | Root     |                                                   | [384]                             |
| 151 | Arudonine               | *S. arundo*           | Root     |                                                   | [64]                              |
| 152 | Solanandaine            | *S. asperum*          | Fruit    |                                                   | [66]                              |
| 153 | Robeneoside A           | *S. lycocarpum*       | Fruit    |                                                   | [182, 447]                        |
| 154 | Robeneoside B           | *S. lycocarpum*       | Fruit    |                                                   | [182, 447]                        |
| 155 | Lobofrutoside           | *S. lycocarpum*       | Fruit    |                                                   | [447]                             |
| 156 | Solanigrloside P        | *S. nigrum*           | Whole    |                                                   | [228]                             |
| 157 | (22R, 25R)-16β-H-22α-N-Spirosol-3β-ol-5-ene 3-O-α-L-rhamnosyl-(1-2)-(α-L-rhamnosyl-(1-4))-β-D-glucoside | *S. surattense* | Aerial | Anticancer                                      | [305]                             |
| 158 | Solaculine A            | *S. aculeastrum*      | Root     |                                                   | [19]                              |
| 159 | β-Solamarine            | *S. aculeastrum*      | Root     |                                                   | [19]                              |
|     |                         | *S. elaeagnifolium*   | Seed     |                                                   | [465]                             |
|     |                         | *S. incanum*          | Root     |                                                   | [155]                             |
| No. | Compounds | Plant sources | Parts | Biological properties | References |
|-----|-----------|---------------|-------|-----------------------|------------|
| 160 | Tomatidenol | S. aculeastrum | Root | [19] |
| 160 | | S. paludosum | Root | [464] |
| 160 | | S. lycopersicum | Fruit | [192] |
| 160 | | S. surattense | Aerial | [454] |
| 161 | Tomatidine 3-O-β-d-glucoside | S. arboreum | Aerial | [63] |
| 162 | Dehydrotomatine | S. lycopersicum | Fruit | [192] |
| 163 | Tomatidine 3-O-(O-β-d-xylosyl-1-6)β-d-glucoside | S. arboreum | Aerial | [63] |
| 164 | Solaverol A | S. uporo | Root | [384] |
| 165 | (23S)-23-hydroxyanguivine | S. uporo | Root | [384] |
| 166 | (23S)-23-hydroxyisoanguivine | S. uporo | Root | [384] |
| 167 | Tomatidine | S. lycopersicum | Fruit | [192] |
| 167 | | | S. aculeastrum | Fruit | Anticancer | [13] |
| 168 | Tomatine | S. lycopersicum | Fruit | [192, 466] |
| 168 | | S. cathayanum | Whole | Neurotoxicity | [106] |
| 168 | | S. sarrachoides | Leaf | [276] |
| 169 | 22-Imido-3-[4′(6″-deoxy-α-L-mannoside)-β-d-glucoside]-5-dehydrospirostane | S. xanthocarpum | Fruit | [407] |
| 170 | Leptinidine | S. paludosum | Root | [253] |
| 170 | | S. orbignianum | Aerial | [250] |
| 171 | Leptinine I | S. orbignianum | Aerial | [250] |
| 172 | Leptinine II | S. orbignianum | Aerial | [250] |
| 173 | Solanine | S. dulcamara | Stem | [467] |
| 173 | | S. indicum | Whole | [162] |
| 173 | | S. tuberosum | Stem | [441] |
| 173 | | S. villosum | Fruit | [468] |
| 174 | α-Chaconine | S. tuberosum | Stem | [372, 441] |
| 175 | β-γ-Glucoside, (3β,23β)23-hydroxysoolanid-5-en-3-yl | S. orbignianum | Aerial | [250] |
| 176 | Solanidine | S. villosum | Fruit | [469] |
| 177 | Solanopubamine | S. schimperianum | Aerial | Antifungal | [279] |
| 178 | Jurubine | S. paniculatum | Fruit | [273, 548] |
| 179 | Etioline | S. spirale | Root | [470] |
| 180 | Deacetyleveralosine | S. spirale | Root | [470] |
| 180 | | S. diphyllum | Root | [126] |
| 181 | Solaspiralidine | S. spirale | Root | [470] |
| 182 | Soladunalinidine | S. arboreum | Aerial | [59] |
| 183 | 3-epi-Soladunalinidine | S. arboreum | Aerial | [59] |
| 184 | Cavauranamide | S. cauvarena | Fruit | Antibacterial | [80] |
| 185 | 4-Tomatiden-3-one | S. cauvarena | Fruit | [80] |
| 186 | 5-Tomatidin-3-one | S. cauvarena | Fruit | [80] |
| 187 | (22S,25S)-3β-aminospirosol-5-ene | S. arboreum | Aerial | [59] |
| 188 | (22R,25R)-3β-amino-5α-spirosolane | S. triste | Aerial | [362, 471] |
| 189 | (22R,25R)-3β-amino-5-spirosolene | S. triste | Aerial | [362, 471] |
| 190 | Isojuripidine | S. asterophorum | Aerial | Spasmolytic | [70] |
| 191 | 23,24-2-methyl-tetrahydrofuranSoladinol | S. cornifolium | Aerial | [472, 473] |
| 192 | Spiraloside C | S. spirale | Fruit | [474] |
| 193 | Spiraloside B | S. spirale | Fruit | [474] |
| 194 | Spiraloside A | S. spirale | Fruit | [474] |
Table 2 (continued)

| No. | Compounds                          | Plant sources | Parts    | Biological properties | References |
|-----|------------------------------------|---------------|----------|-----------------------|------------|
| 195 | Soladulcine A                      | *S. dulcamara* | Aerial   |                       | [433]      |
| 196 | Soladulcine B                      | *S. dulcamara* | Aerial   |                       | [433]      |
| 197 | Esculeoside A                      | *S. lycopersicum* | Fruit   |                       | [475]      |
| 198 | Solanigroside A                    | *S. nigrum*   | Whole    |                       | [476]      |
| 199 | Solanigroside B                    | *S. nigrum*   | Whole    |                       | [476]      |
| 200 | 5α-Pregn-16-en-3β-ol-20-one lycotetraoside | *S. nigrum* | Whole    |                       | [476]      |
| 201 | (5α)-3-Hydroxypregn-16-en-20-one    | *S. lycutom*  | Whole    |                       | [194]      |
| 202 | Hypoglaucin H                      | *S. nigrum*   | Whole    |                       | [476]      |
| 203 | 16-Dehydroprogrenolone             | *S. lyculum*  | Aerial   | Anticancer            | [437]      |
| 204 | 16-dehydroprogrenolone 3-O-α-L-rhamnosyl-1-2β-D-glucosiduronic acid | *S. lyculum* | Whole    | Anticancer            | [194]      |
| 205 | Torvpregnanoside A                 | *S. torvum*   | Aerial   |                       | [317, 331] |
| 206 | 5α-pregn-16-en-3,20-dione-6α-ol-6-O-[α-L-rhamnosyl-1-2β-D-glucosiduronic acid] | *S. torvum* | Fruit    | Anticancer            | [317]      |
| 207 | Torvpregnanoside B                 | *S. torvum*   | Aerial   |                       | [331]      |
| 208 | Ganaxolone                         | *S. torvum*   | Aerial   |                       | [323]      |
| 209 | Allopregnanolone                   | *S. torvum*   | Aerial   |                       | [323]      |
| 210 | Pregnanolone                       | *S. torvum*   | Aerial   |                       | [323]      |
| 211 | Betulinic acid                     | *S. buddleifolium* | Stem    |                       | [79]       |
| 212 | Lupeol                             | *S. cathayanum* | Aerial   |                       | [472, 473, 477] |
|     |                                    | *S. schimperianum* | Aerial   |                       | [278]      |
|     |                                    | *S. spirale*   | Leaf     | Anticancer            | [297]      |
| 213 | Cycloeucalenone                     | *S. cernuum*   | Leaf     | Anticancer            | [107]      |
| 214 | 24-oxo-31-norcycloartanone          | *S. cernuum*   | Leaf     | Anticancer            | [107]      |
| 215 | Friedelin                          | *S. lycopersicum* | Seed    |                       | [478]      |
| 216 | Ursolic acid                       | *S. lycutom*   | Whole    |                       | [197]      |
|     |                                    | *S. torvum*   | Aerial   |                       | [463]      |
|     |                                    | *S. xanthocarpum* | Root    |                       | [427]      |
| 217 | 2α,3β-Dihydroxyursolic acid        | *S. torvum*   | Aerial   |                       | [463]      |
| 218 | Daturaoline                        | *S. arundo*    | Whole    |                       | [65]       |
| 219 | Carbenoxolone                      | *S. cernuum*   | Leaf     |                       | [109]      |
| 220 | β-Amyrin                           | *S. melongena* | Aerial   |                       | [439]      |
| 221 | Oleanolic acid                     | *S. torvum*   | Aerial   |                       | [463]      |
|     |                                    | *S. xanthocarpum* | Root    |                       | [427]      |
| 222 | 2α-Hydroxyoleanolic acid           | *S. torvum*   | Aerial   |                       | [463]      |
| 223 | 3β-Acetoxy-11α,12α-epoxyoleanan-13β,28-olide | *S. torvum* | Aerial   |                       | [463]      |
| 224 | Solanoglycosydane I                | *S. torvum*   | Fruit    |                       | [314]      |
| 225 | Phytol                             | *S. pseudocapsicum* | Leaf    |                       | [263]      |
|     |                                    | *S. villosa* | Leaf     |                       | [434, 479] |
| 226 | Kaur-16-ene                        | *S. aculeastrum* | Leaf    |                       | [11]       |
| 227 | Solanerioside A                    | *S. erianthum* | Leaf    |                       | [138]      |
| 228 | Tricalysioside U                   | *S. violaceum* | Whole    |                       | [392]      |
| 229 | Roseoside                          | *S. erianthum* | Leaf    |                       | [138]      |

**Pregnane glycosides**

**Triterpenes**

**Diterpenes**

**Sesquiterpenes**
| No. | Compounds | Plant sources | Parts | Biological properties | References |
|-----|-----------|---------------|-------|-----------------------|------------|
| 230 | (6E,10E)-5,12-Dihydroxy-ß-nerolidol 5-O-β-d-glucoside | *S. erianthum* | Leaf | | [138] |
| 231 | Amarantholdioside IV | *S. erianthum* | Leaf | | [138] |
| 232 | 3β-Hydroxysolavetivone | *S. abutiloides* | Root | Antifungal | [3] |
| 233 | Solavetivone | *S. abutiloides* | Root | Antifungal | [3] |
|     |           | *S. aethiopicum* | Root | | [29] |
|     |           | *S. indicum* | Root | | [163] |
|     |           | *S. jabrense* | Aerial | | [166] |
| 234 | 13-Hydroxysolavetivone | *S. buddleifolium* | Stem | | [79] |
|     |           | *S. aethiopicum* | Root | Antifungal | [29] |
| 235 | Lubimin | *S. abutiloides* | Root | Antifungal | [3] |
|     |           | *S. aethiopicum* | Root | | [29] |
| 236 | Lubiminoic acid | *S. aethiopicum* | Root | | [29] |
| 237 | Epilubimin | *S. aethiopicum* | Root | | [29] |
| 238 | Epilubiminoic acid | *S. aethiopicum* | Root | | [29] |
| 239 | Lubimol | *S. aethiopicum* | Root | | [29] |
| 240 | α-Farnesene | *S. aculeastrum* | Leaf | | [11] |
| 241 | Nerolidol | *S. aculeastrum* | Leaf | | [11] |
| 242 | 2,7,10-Trimethylundecane | *S. aculeastrum* | Leaf | | [11] |
| 243 | Aethione | *S. aethiopicum* | Root | | [29] |
| 244 | Anhydro-ß-rotonol | *S. aethiopicum* | Root | | [29] |
| 245 | (45,5R,7S)-4,11-Dihydroxy-guaia-1(2),9(10)-dien | *S. erianthum* | Stem | | [480] |
| 246 | Caryophyllene | *S. erianthum* | Fruit | | [481] |
| 247 | Cadina-1(10),4-diene | *S. erianthum* | Fruit | | [481] |
| 248 | α-Gurjunene | *S. erianthum* | Fruit | | [481] |
| 249 | Globulol | *S. erianthum* | Fruit | | [481] |
| 250 | α-Guaiene | *S. erianthum* | Fruit | | [481] |
| 251 | α-Calacorene | *S. erianthum* | Fruit | | [481] |
| 252 | 2-naphthalenemethanol | *S. erianthum* | Fruit | | [481] |
| 253 | Octahydro-2,2-dimethyl-4a,7a-ethano-5H-cyclobut[e]inden-5-ol | *S. erianthum* | Fruit | | [481] |
| 254 | 4,5-Dehydroisolongifolene | *S. erianthum* | Fruit | | [481] |
| 255 | α-Caryophyllene | *S. erianthum* | Fruit | | [481] |
| 256 | Solafuranone | *S. indicum* | Root | | [163] |
| 257 | Lyratol D | *S. lyratum* | Whole | Anticancer | [199] |
|     |           | *S. septemlobum* | Whole | | [482] |
| 258 | Solajiangxin B | *S. lyratum* | Whole | Anticancer | [198] |
|     |           | *S. septemlobum* | Whole | | [482] |
| 259 | Septemlobin D | *S. septemlobum* | Whole | | [483] |
| 260 | Blumenol A | *S. lyratum* | Whole | Anticancer | [199, 484] |
| 261 | Blumenol C | *S. lyratum* | Whole | | [484] |
| 262 | Dehydromificioioli | *S. lyratum* | Whole | Anticancer | [199, 484] |
| 263 | Grasshopper ketone | *S. lyratum* | Whole | | [484] |
| 264 | 6α-Epoxy-7-megastigmen-9-one | *S. lyratum* | Whole | | [484] |
| 265 | (1′R,2′R,5′S,10′R)2-1′,2′-dihydroxy-1′-,methyl(methylene)6,10-dimethylspiro[4, 5] 6H-cyclobut[e]inden-5-ol | *S. lyratum* | Whole | | [484] |
### Table 2 (continued)

| No. | Compounds                                                                 | Plant sources | Parts        | Biological properties | References |
|-----|---------------------------------------------------------------------------|---------------|--------------|-----------------------|------------|
| 266 | (1′S,2R,5S,10R)-2-1′,2′-dihydroxy-1′-methyl-6,10-dimethylspiro[4, 5]dec-6-en-8-one | S. lyratum    | Whole        |                       | [484]      |
| 267 | 2-1′,2′-dihydroxy-1′-methyl-6,10-dimethyl-9-hydroxy-spiro[4, 5]dec-6-en-8-one | S. lyratum    | Whole        |                       | [200, 484]|
| 268 | Boscialin                                                                 | S. lyratum    | Whole        |                       | [484]      |
| 269 | 1′-Hydroxy-1,2-dihydro-α-santonin                                         | S. lyratum    | Whole        |                       | [193, 484]|
| 270 | Lyratol A                                                                 | S. lyratum    | Whole        |                       | [485]      |
| 271 | Lyratol B                                                                 | S. lyratum    | Whole        |                       | [485]      |
|     |                                                                            | S. septemlobum| Whole        |                       | [482]      |
| 272 | Lyratol C                                                                 | S. lyratum    | Whole        |                       | [199]      |
| 273 | Lyratol G                                                                 | S. lyratum    | Whole        |                       | [196]      |
| 274 | Solajiangxin A                                                            | S. lyratum    | Whole        |                       | [198]      |
| 275 | Solajiangxin C                                                            | S. lyratum    | Whole        |                       | [198]      |
| 276 | Solajiangxin D                                                            | S. lyratum    | Whole        |                       | [200]      |
|     |                                                                            | S. septemlobum| Whole        |                       | [482]      |
| 277 | Solajiangxin E                                                            | S. lyratum    | Whole        |                       | [200]      |
| 278 | Solajiangxin F                                                            | S. lyratum    | Whole        |                       | [197]      |
|     |                                                                            | S. septemlobum| Whole        |                       | [482]      |
| 279 | Solajiangxin G                                                            | S. lyratum    | Whole        |                       | [197]      |
| 280 | 2-hydroxysolajiangxin E                                                   | S. lyratum    | Whole        |                       | [200]      |
| 281 | Dehydrocarissone                                                          | S. lyratum    | Whole        |                       | [486]      |
|     |                                                                            | S. septemlobum| Whole        |                       | [482]      |
| 282 | Atractylenolide I                                                          | S. lyratum    | Stem         |                       | [486]      |
| 283 | Ligucyperonol                                                             | S. septemlobum| Whole        |                       | [482]      |
| 284 | Nardoeudesmol A                                                           | S. septemlobum| Whole        |                       | [482]      |
| 285 | Solanerianone A                                                           | S. septemlobum| Whole        |                       | [482]      |
| 286 | Pterocarptiol                                                             | S. torvum     | Root         |                       | [487]      |
| 287 | Selina-3′β,4α,11-triol                                                    | S. torvum     | Root         |                       | [487]      |
| 288 | 2-(1′,2′-dihydroxy-1′-methyl-6,10-dimethylspiro[4, 5]dec-6,9-dien-8-one     | S. torvum     | Root         |                       | [487]      |
| 289 | 10β,12,14-Trihydroxy-α-aromadendrane                                      | S. torvum     | Root         |                       | [487]      |
| 290 | 10β,13,14-Trihydroxy-α-aromadendrane                                      | S. torvum     | Root         |                       | [487]      |
| 291 | 2-(1′,2′-dihydroxy-1′-methyl-6,10-dimethyl-9-hydroxy-spirodec-6-en-8-one    | S. torvum     | Root         |                       | [487]      |
| 292 | 1β,10β,12,14-Tetrahydroxy-α-aromadendrane                                  | S. torvum     | Root         |                       | [487]      |
| 293 | 1β,10β,13,14-Tetrahydroxy-α-aromadendrane                                  | S. torvum     | Root         |                       | [487]      |
| 294 | Teferidin                                                                 | S. schimperianum| Aerial    |                       | [278]      |
| 295 | Teferin                                                                   | S. schimperianum| Aerial    |                       | [278]      |
| 296 | Ferutinin                                                                 | S. schimperianum| Aerial    |                       | [278]      |
| 297 | Bisabolol                                                                 | S. schimperianum| Fruit    |                       | [488]      |
| 298 | 11,12-O-Isopropylidenesolajiangxin F                                      | S. septemlobum| Whole        |                       | [483]      |
| 299 | Eudesmane                                                                 | S. septemlobum| Whole        |                       | [281]      |
| 300 | Vitispirane                                                               | S. septemlobum| Whole        |                       | [281]      |
| 301 | Septemlobin A                                                             | S. septemlobum| Whole        |                       | [281]      |
| 302 | Septemlobin B                                                             | S. septemlobum| Whole        |                       | [281]      |
| 303 | Septemlobin C                                                             | S. septemlobum| Whole        |                       | [281]      |
Table 2 (continued)

| No. | Compounds | Plant sources | Parts   | Biological properties | References |
|-----|-----------|---------------|---------|-----------------------|------------|
| 304 | 3β,11-dihydroxy-4,14-oxideeudesmane | S. torvum | Root    |                       | [487]      |
| 305 | Aromadendrene oxide | S. erianthum | Fruit   |                       | [481]      |
| 306 | Thujocone | S. betaceum | Fruit   |                       | [77]       |
| 307 | α-Cedrene | S. betaceum | Fruit   |                       | [77]       |
| 308 | Cedrol | S. betaceum | Fruit   |                       | [77]       |
| 309 | α-Hexylcinnamaldehyde | S. betaceum | Fruit   |                       | [77]       |
| 310 | β-Cadinene | S. betaceum | Fruit   |                       | [77]       |
| 311 | Decanal | S. aculeastrum | Leaf    |                       | [11]       |
| 312 | Decane | S. aculeastrum | Leaf    |                       | [11]       |
| 313 | 2,4-Decadienal | S. aculeastrum | Leaf    |                       | [11]       |
| 314 | 1,8-Cineole | S. betaceum | Fruit   |                       | [77]       |
| 315 | Terpinen-4-ol | S. betaceum | Fruit   |                       | [77]       |
| 316 | Linalool | S. vestissimum | Fruit   |                       | [489, 490] |
| 317 | Geraniol | S. vestissimum | Fruit   |                       | [490]      |
| 318 | Limonene | S. vestissimum | Fruit   |                       | [490]      |
| 319 | β-Cyclocitrinal | S. aculeastrum | Leaf    |                       | [11]       |
| 320 | β-Ionom | S. aculeastrum | Leaf    |                       | [11]       |
|    |           | S. pseudocapsicum | Leaf    |                       | [263]      |
| 321 | 1, 2-Dihydro-1,1,6-trimethyl-naphthalene | S. betaceum | Fruit   |                       | [77]       |
| 322 | trans-β-Damascenone | S. aculeastrum | Leaf    |                       | [11]       |
| 323 | Loliolide | S. erianthum | Leaf    |                       | [137]      |
|    |           | S. americanum | Aerial   |                       | [49]       |
|    |           | S. pseudocapsicum | Leaf    |                       | [263]      |
| 324 | Hotrienol | S. vestissimum | Fruit   |                       | [468, 490] |
| 325 | Neroloxide | S. vestissimum | Fruit   |                       | [468]      |
| 326 | 5-Ethynyltetrahydro-α,α,5-trimethyl-2-furanmethanol | S. vestissimum | Fruit   |                       | [490]      |
| 327 | Nerol | S. vestissimum | Fruit   |                       | [490]      |
| 328 | 8-Hydroxylinalool | S. vestissimum | Fruit   |                       | [491]      |
| 329 | (R)-Linalyl β-ω-glucoside | S. vestissimum | Fruit   |                       | [492]      |
| 330 | (1R,4E)-1-Ethenyl-6-hydroxy-1,5-dimethyl-4-hexen-1-yl β-ω-glucoside | S. vestissimum | Fruit   |                       | [492]      |
| 331 | (R)-Linalyl β-vicianoside | S. vestissimum | Fruit   |                       | [492]      |
| 332 | 6-O-linked β-ω-glucoside of (R)E2,6-dimethyl-3,7-octadiene-2,6-diol | S. vestissimum | Fruit   |                       | [468]      |
| 333 | (3E,6R)-2,6-Dimethyl-3,7-octadiene-2,6-diol | S. vestissimum | Fruit   |                       | [468]      |
| 334 | p-Cymenene | S. betaceum | Fruit   |                       | [77]       |
| 335 | Dihydroactinidiolide | S. erianthum | Leaf    |                       | [137]      |
| 336 | Apiol | S. sessiliflorum | Fruit   |                       | [488]      |
| 337 | α-Terpenen-7-al | S. betaceum | Fruit   |                       | [77]       |
| 338 | 1,3,8-p-Menthatriene | S. betaceum | Fruit   |                       | [77]       |
|    | Flavonoids |          |         |                       |            |
| 339 | Vitecetin | S. agrarium | Aerial   |                       | [31]       |
Table 2 (continued)

| No. | Compounds                          | Plant sources               | Parts     | Biological properties | References                  |
|-----|------------------------------------|-----------------------------|-----------|-----------------------|------------------------------|
| 340 | Quercetin                          | *S. anguvi*                  | Fruit     | Anticancer            | [31]                         |
|     |                                    | *S. elaegnifolium*           | Seed      |                       | [493]                        |
|     |                                    | *S. incanum*                 | Aerial    |                       | [494]                        |
|     |                                    | *S. melongena*               | Stem      |                       | [205]                        |
|     |                                    | *S. muricatum*               | Whole     |                       | [215]                        |
|     |                                    | *S. nigra*                   | Leaf      |                       | [92–98, 230–238, 495–497]    |
|     |                                    | *S. torvum*                  | Whole     |                       | [498]                        |
| 341 | Kaempferol 7-O-rhamnoside          | *S. asperum*                 | Fruit     |                       | [67]                         |
| 342 | Rutin                              | *S. anguvi*                  | Fruit     | Anticancer            | [31]                         |
|     |                                    | *S. melongena*               | Stem      |                       | [499, 500]                   |
|     |                                    | *S. muricatum*               | Fruit     |                       | [215]                        |
|     |                                    | *S. nigra*                   | Leaf      |                       | [230]                        |
|     |                                    | *S. spirales*                | Aerial    |                       | [470]                        |
| 343 | Kaempferol 3-rutinoside-7-rhamnoside| *S. asperum*              | Fruit     |                       | [67]                         |
| 344 | Afzelin                            | *S. cernuum*                 | Leaf      |                       | [109, 112, 501]              |
| 345 | Quercitrin                         | *S. cernuum*                 | Leaf      |                       | [109]                        |
|     |                                    | *S. melongena*               | Stem      |                       | [205]                        |
| 346 | Astragalin                         | *S. cernuum*                 | Leaf      |                       | [501]                        |
|     |                                    | *S. crinitum*                | Aerial    |                       | [459]                        |
|     |                                    | *S. incanum*                 | Aerial    |                       | [494]                        |
|     |                                    | *S. elaegnifolium*           | Aerial    |                       | [502]                        |
| 347 | Kaempferol 3-O-[(α-apiofuranosyl-(1-2)]-α-rhamnoside| *S. cernuum*             | Leaf      |                       | [501]                        |
| 348 | Kaempferol 3-O-[(α-apiofuranosyl-(1-2)]-β-galactoside| *S. cernuum*             | Leaf      |                       | [501]                        |
| 349 | Tiliroside                         | *S. asperum*                 | Fruit     |                       | [67]                         |
|     |                                    | *S. crinitum*                | Aerial    |                       | [123, 459]                   |
|     |                                    | *S. elaegnifolium*           | Whole     | Anticancer            | [503]                        |
|     |                                    | *S. cernuum*                 | Leaf      |                       | [501]                        |
| 350 | *cis*-Tiliroside                   | *S. cernuum*                 | Leaf      |                       | [501]                        |
|     |                                    | *S. elaegnifolium*           | Aerial    |                       | [502]                        |
| 351 | Kaempferol                         | *S. crinitum*                | Aerial    |                       | [459]                        |
|     |                                    | *S. elaegnifolium*           | Whole     |                       | [504]                        |
|     |                                    | *S. incanum*                 | Aerial    |                       | [494]                        |
|     |                                    | *S. indicum*                 | Whole     |                       | [505]                        |
|     |                                    | *S. nigra*                   | Leaf      |                       | [227]                        |
|     |                                    | *S. surattense*              | Whole     |                       | [99]                         |
|     |                                    | *S. torvum*                  | Whole     |                       | [498]                        |
| 352 | Camelliaside C                     | *S. erianthum*               | Leaf      |                       | [137]                        |
| 353 | Baimaside                          | *S. incanum*                 | Aerial    |                       | [506]                        |
| 354 | Narcissin                          | *S. glabratum*               | Aerial    |                       | [141]                        |
| 355 | Isorhamnetin 3-glucoside           | *S. incanum*                 | Aerial    |                       | [506]                        |
| 356 | Populin                           | *S. elaegnifolium*           | Aerial    |                       | [502]                        |
| 357 | Quercetin 3-O-robinoside           | *S. paniculatum*             | Aerial    |                       | [258]                        |
| 358 | Kaempferol 3-O-(6"-O-cis-p-coumaroyl)-O-β-galactoside | *S. elaegnifolium*           | Aerial    |                       | [502]                        |
| 359 | Myricetin-3-galactoside            | *S. melongena*               | Stem      |                       | [205]                        |
| 360 | Apigenin                           | *S. lyratum*                 | Whole     |                       | [507]                        |
|     |                                    | *S. torvum*                  | Whole     |                       | [498]                        |
Table 2 (continued)

| No. | Compounds                        | Plant sources | Parts  | Biological properties | References |
|-----|----------------------------------|---------------|--------|-----------------------|------------|
| 361 | Pelanin                          | *S. tuberosum*| Stem   |                       | [508]      |
| 362 | Petanin                          | *S. tuberosum*| Stem   |                       | [508]      |
| 363 | Peonanin                         | *S. tuberosum*| Stem   |                       | [508]      |
| 364 | Keracyanin                       | *S. betaceum* | Fruit  | Anticancer            | [75, 76]   |
| 365 | Pelargonidin 3-rutinoside        | *S. betaceum* | Fruit  | Anticancer            | [75, 76]   |
| 366 | Tulipanin                        | *S. betaceum* | Fruit  | Anticancer            | [75, 76]   |
| 367 | Delphinidin 3-O-α-L-rhamnosyl-(1-6)-β-D-glucoside-3′-O-β-D-glucoside | *S. betaceum* | Fruit  | Anticancer            | [75, 76]   |
| 368 | Cyanidin 3-O-(2″-O-xylosyl)rutinoside | *S. betaceum* | Fruit  |                       | [76]       |
| 369 | Asterin                          | *S. betaceum* | Fruit  |                       | [76]       |
| 370 | Biochanin A-7-O-β-D-apiofuranosyl-1-5| *S. crinitum* | Fruit  |                       | [122]      |
| 371 | 2R,3R-5,7,4‴-trihydroxy-dihydroflavone-3-O-α-D-glucosyl-6″-O-β-D-glucoside-6‴-p-hydroxy benzoate | *S. elaegnifolium* | Whole  | Anticancer            | [503]      |
| 372 | 6,2‴,3‴,5‴,4‴-Pentahydroxy-3,7‴-biflavone | *S. dulcamara* | Fruit  |                       | [130]      |
| 373 | Kaempferol 8-C-β-D-galactoside   | *S. elaegnifolium* | Aerial | Hepatoprotective      | [502]      |
| 374 | Kaempferol 8-C-glucoside         | *S. elaegnifolium* | Aerial |                       | [502]      |
| 375 | Kaempferol 6-C-glucoside         | *S. elaegnifolium* | Aerial |                       | [502]      |
| 376 | Vitexin                          | *S. elaegnifolium* | Aerial |                       | [502]      |
| 377 | Vicenin II                       | *S. elaegnifolium* | Aerial |                       | [502]      |
| 378 | Quercetin 6-C-β-glucoside        | *S. elaegnifolium* | Aerial |                       | [502]      |
| 379 | Quercetin 3-O-β-galactoside      | *S. elaegnifolium* | Aerial |                       | [502]      |
| 380 | Isoquercitrin                    | *S. elaegnifolium* | Aerial |                       | [502–504] |
|     |                                  | *S. incanum*  | Aerial |                       | [494]      |
|     |                                  | *S. torvum*   | Root   |                       | [338]      |
|     |                                  | *S. melongena* | Stem   |                       | [205]      |
| 381 | Quercetin 3-O-β-apiofuranosyl-(1-2)-O-β-D-galactoside | *S. elaegnifolium* | Aerial |                       | [502]      |
| 382 | 5-Hydroxy,7,2‴,3‴,5‴-tetramethoxylavone | *S. glabratum* | Whole  |                       | [140]      |
| 383 | Combretrol                       | *S. glabratum* | Whole  |                       | [140]      |
| 384 | Baicalin                         | *S. incanum*  | Aerial |                       | [506]      |
| 385 | Kaempferol 3-O(6‴-O-2,5-dihydroxycinnamoyl)-β-D-glucosyl(1-2)β-D-glucoside | *S. incanum* | Aerial |                       | [506]      |
| 386 | (±)-Naringenin                   | *S. indicum*  | Whole  |                       | [505]      |
|     |                                  | *S. nienkui*  | Whole  |                       | [509]      |
|     |                                  | *S. sessiflorum* | Fruit  |                       | [510]      |
|     |                                  | *S. surattense* | Whole  |                       | [99]       |
| 387 | Manghaslin                       | *S. lycopersicum* | Fruit  |                       | [511]      |
| 388 | Genkwanin                        | *S. jabrense* | Aerial |                       | [167]      |
|     |                                  | *S. palodum*  | Aerial |                       | [512]      |
| 389 | Ombuine                          | *S. jabrense* | Aerial |                       | [167]      |
| 390 | Rhamnocitrin                     | *S. jabrense* | Aerial |                       | [167]      |
|     |                                  | *S. palodum*  | Aerial |                       | [513]      |
| 391 | Retusin                          | *S. jabrense* | Aerial |                       | [167]      |
|     |                                  | *S. palodum*  | Aerial |                       | [512]      |
|     |                                  | *S. schimperianum* | Aerial |                       | [278]      |
|     |                                  | *S. torvum*   | Fruit  |                       | [322]      |
| 392 | Pentamethoxyquercetin            | *S. jabrense* | Aerial |                       | [167]      |
### Table 2 (continued)

| No. | Compounds                              | Plant sources | Parts       | Biological properties           | References   |
|-----|----------------------------------------|---------------|-------------|--------------------------------|--------------|
| 393 | 3-O-Methylquercetin                     | *S. jabrense* | Aerial      |                                | [167]        |
| 394 | Kumatakenin                             | *S. jabrense* | Aerial      |                                | [167]        |
| 395 | 3'-Hydroxyflindulatin                   | *S. jabrense* | Aerial      |                                | [167]        |
| 396 | 3,7,8-Trimethylherbacetin               | *S. jabrense* | Aerial      |                                | [167]        |
| 397 | 3,7,8,3',4'-Pentamethylgossypetin       | *S. jabrense* | Aerial      |                                | [167]        |
| 398 | Diosmetin                               | *S. nienkui*  | Whole       |                                | [509]        |
| 399 | Formononetin                            | *S. lyratum*  | Whole       |                                | [514]        |
| 400 | Ononin                                  | *S. lyratum*  | Whole       |                                | [514]        |
| 401 | Daidzein                                | *S. lyratum*  | Whole       |                                | [507, 514]   |
| 402 | Genistin                                | *S. lyratum*  | Whole       |                                | [514]        |
| 403 | 5-Hydroxyxylononin                      | *S. lyratum*  | Whole       |                                | [514]        |
| 404 | 2,7-Dihydoxy-3-(4-hydroxyphenyl)-5-methoxy-4H-1-benzopyran-4-one | *S. nienkui* | Whole       |                                | [509]        |
| 405 | 5-hydroxy-3,7,4'-trimethoxyflavone      | *S. schimperianum* | Aerial |                                | [278]        |
| 406 | Kaempferol-3-O-β-d-glucoside            | *S. schimperianum* | Aerial |                                | [278]        |
| 407 | Luteolin                                | *S. schimperianum* | Aerial |                                | [278]        |
| 408 | Tamarkin                                | *S. torvum*   | Whole       |                                | [498]        |
| 409 | Torvanol A                              | *S. torvum*   | Root        | Antidepressant, antiviral      | [322, 332]   |
| 410 | 5-methoxy-(3,4"-dihydro-3",4"-diacetoxy)-2",2"-dimethyl-(7,8,5",6")-flavone | *S. erianthus* | Leaf       |                                | [137]        |
| 411 | 5,7,8,4'-tetrahydroxy-3-methoxyflavone-8-O-β-d-xiloside | *S. rostratum* | Aerial     |                                | [515]        |
| 412 | 3-O-Methylquercetin 3-O-β-β-galactoside | *S. rostratum* | Whole      |                                | [516]        |
| 413 | 3-O-Methylquercetin 3-O-β-β-glucoside   | *S. rostratum* | Whole      |                                | [516]        |
|     | Lignans                                 |               |            |                                |              |
| 414 | Isolariciresinol                        | *S. buddleifolium* | Stem     |                                | [79]         |
| 415 | 5-Methoxyisolariciresinol               | *S. buddleifolium* | Stem     |                                | [79]         |
| 416 | Polystachiol                            | *S. buddleifolium* | Stem     |                                | [79]         |
| 417 | (+)-Lyoniresinol 3-O-β-glucoside        | *S. buddleifolium* | Stem     |                                | [79]         |
| 418 | (-)-Lyoniresinol 3-O-β-glucoside        | *S. buddleifolium* | Stem     |                                | [79]         |
| 419 | Alangilignoside C                       | *S. buddleifolium* | Stem     |                                | [79]         |
| 420 | (+)-(7'SR,7'E)-4-Hydroxy-3,5,5',9'-tetram ethoxy-4',7-epoxy-8,3-neo-lign-7'-en-9-ol | *S. erianthus* | Stem     |                                | [480]        |
| 421 | (-)-(7'R,8S,7'E)-4-Hydroxy-3,5,5',9'-tetramethoxy-4',7-epoxy-8,3-neo-lign-7'-en-9-ol | *S. erianthus* | Stem     |                                | [480]        |
| 422 | Liriodendrin                            | *S. lyratum*  | Whole       |                                | [517]        |
| 423 | Syringaresinol                          | *S. lyratum*  | Whole       |                                | [517]        |
|     |                                         | *S. nigrum*   | Whole       |                                | [496]        |
|     |                                         | *S. surattense*  | Whole      |                                | [518]        |
| 424 | Melongenamide A                         | *S. melongena* | Root       |                                | [210]        |
| 425 | Cannabisin D                           | *S. melongena* | Root       | Anti-inflammatory              | [210]        |
| 426 | Melongenamide B                         | *S. melongena* | Root       | Anti-inflammatory              | [210]        |
| 427 | Grossamide                              | *S. melongena* | Root       | Anti-inflammatory              | [210]        |
| 428 | Melongenamide C                         | *S. melongena* | Root       | Anti-inflammatory              | [210]        |
Table 2 (continued)

| No. | Compounds                                                                 | Plant sources   | Parts       | Biological properties | References |
|-----|---------------------------------------------------------------------------|-----------------|-------------|-----------------------|------------|
| 429 | Cannabisin F                                                              | *S. melongena*  | Root        | Anti-inflammatory      | [210]      |
| 430 | Melongenamide D                                                           | *S. melongena*  | Root        | Anti-inflammatory      | [210]      |
| 431 | Cannabisin G                                                              | *S. melongena*  | Root        | Anti-inflammatory      | [210]      |
| 432 | 1,2-dihydro-6,8-dimethoxy-7-hydroxy-1-(3,5-dimethoxy-4-hydroxyphenyl)-N\(^1\),N\(^2\)-bis-[2-(4-hydroxyphenyl)ethyl]-2,3-naphthalene dicarboxamide | *S. melongena*  | Root        |                        | [210]      |
| 433 | Sisymbrifolin                                                             | *S. sisymbriifolium* | Fruit      |                        | [519]      |
| 434 | Grossamides K                                                            | *S. melongena*  | Root        |                        | [210]      |
| 435 | Pinoresinol                                                               | *S. nigrum*     | Whole       |                        | [496]      |
| 436 | Pinoresinol 4-O-β-D-glucoside                                            | *S. nigrum*     | Whole       |                        | [520]      |
| 437 | Medioresinol                                                              | *S. nigrum*     | Whole       |                        | [496]      |
| 438 | Syringaresinol-4′-O-β-D-glucoside                                         | *S. nigrum*     | Whole       |                        | [520]      |
| 439 | Glycosmic acid                                                            | *S. surattense* | Whole       |                        | [518]      |
| 440 | Simulanol                                                                 | *S. surattense* | Whole       |                        | [518]      |
| 441 | Balanophonin                                                              | *S. surattense* | Whole       |                        | [518]      |
| 442 | Ficusl                                                                    | *S. melongena*  | Root        |                        | [209]      |
| 443 | Tribulasamide A                                                           | *S. surattense* | Whole       |                        | [518]      |
| 444 | Clemastanin B                                                             | *S. torvum*     | Fruit       |                        | [521]      |

**Other alkaloids**

| No. | Compounds                                                                 | Plant sources   | Parts       | Biological properties | References |
|-----|---------------------------------------------------------------------------|-----------------|-------------|-----------------------|------------|
| 445 | Xyloganatinine                                                            | *S. cathayanum* | Stem        |                        | [477]      |
| 446 | Cernumidine                                                               | *S. cernuum*    | Leaf        |                        | [109, 111, 112] |
| 447 | Isocernumidine                                                            | *S. cernuum*    | Leaf        |                        | [111]      |
| 448 | Cernidine                                                                 | *S. cernuum*    | Leaf        |                        | [501]      |
| 449 | Ethyl orotate                                                             | *S. cathayanum* | Stem        |                        | [103, 477] |
| 450 | 3-Indolecarboxylic acid                                                   | *S. americanum* | Aerial      |                        | [49]       |
| 451 | L-Valyl-l-isoleucyl-l-leucine                                             | *S. asperum*    | Fruit       |                        | [67]       |
| 452 | 2-Methyltetrahydro-β-carboline                                            | *S. jabrense*   | Aerial      |                        | [166]      |
| 453 | Proline                                                                   | *S. asperum*    | Fruit       |                        | [67]       |
| 454 | Acetamide                                                                 | *S. schimperianum* | Aerial    |                        | [277]      |
| 455 | Stearamide                                                                | *S. schimperianum* | Aerial    |                        | [277]      |
| 456 | (6E, 9E)\(\text{N},N\)-dimethyloctadeca-6,9-dienamide                    | *S. schimperianum* | Aerial    |                        | [277]      |
| 457 | (2E)-3-(4-Hydroxyphenyl)-N-{[2S]-2-(4-hydroxyphenyl)-2-methoxyethyl}-2-propenamide | *S. torvum*     | Aerial      |                        | [450]      |
| 458 | 4-Coumaroyltyramine                                                       | *S. buddleifolium* | Stem      |                        | [79]       |
|     |                                                                           | *S. cathayanum* | Stem        |                        | [522]      |
|     |                                                                           | *S. indicum*    | Root        |                        | [163]      |
|     |                                                                           | *S. melongena*  | Root        |                        | [209]      |
|     |                                                                           | *S. surattense* | Whole       |                        | [518]      |
|     |                                                                           | *S. torvum*     | Aerial      |                        | [338]      |
|     |                                                                           | *S. lyratum*    | Whole       |                        | [507]      |
| 459 | \(\text{N}\)-\text{trans}\)-Feruloyltyramine                           | *S. buddleifolium* | Stem      |                        | [79]       |
|     |                                                                           | *S. cathayanum* | Stem        |                        | [522]      |
|     |                                                                           | *S. indicum*    | Root        |                        | [163]      |
|     |                                                                           | *S. melongena*  | Root        | Antidiabetic            | [209]      |
|     |                                                                           | *S. lyratum*    | Whole       |                        | [507]      |
Table 2 (continued)

| No. | Compounds                                      | Plant sources       | Parts     | Biological properties | References |
|-----|------------------------------------------------|---------------------|-----------|-----------------------|------------|
| 460 | \(N\)-trans-Feruloylmethoxytyramine           | \(S. \)buddleifolium| Stem      |                       | [79]       |
|     |                                                | \(S. \)cathayanum   | Stem      |                       | [522]      |
| 461 | \(N\)-trans-Caffeoyltyramine                  | \(S. \)buddleifolium| Stem      |                       | [79]       |
| 462 | \(N\)-trans-Feruloyldopamine                  | \(S. \)buddleifolium| Stem      |                       | [79]       |
| 463 | \(N\)-trans-Feruloyloctopamine                | \(S. \)cathayanum   | Stem      |                       | [522]      |
|     |                                                | \(S. \)septemlobum  | Aerial    |                       | [523]      |
| 464 | \(N\)-trans-\(p\)-coumaroyloctopamine        | \(S. \)americanum   | Aerial    | Antidiabetic          | [49]       |
|     |                                                | \(S. \)torvum       | Aerial    |                       | [524]      |
| 465 | \(N\)-trans-\(p\)-feruloyloctopamine         | \(S. \)americanum   | Aerial    | Antidiabetic          | [49]       |
| 466 | \(N\)-trans-\(p\)-coumaroylyramine           | \(S. \)americanum   | Aerial    | Antidiabetic          | [49]       |
|     |                                                | \(S. \)melongena    | Root      |                       |            |
| 467 | \(N\)-trans-\(p\)-feruloytyramine            | \(S. \)americanum   | Aerial    | Antidiabetic          | [49]       |
|     |                                                | \(S. \)torvum       | Aerial    |                       | [524]      |
| 468 | \(N\)-cis-\(p\)-Coumaroytyramine             | \(S. \)melongena    | Root      |                       | [209]      |
| 469 | Caffeoylputrescine                             | \(S. \)melongena    | Stem      |                       | [205]      |
| 470 | 3-(3,4-Dihydroxyphenyl)-N-[3-[[4-[(3,4-     | \(S. \)melongena    | Stem      |                       | [205]      |
|     | dihydroxyphenyl)-1-oxo-2-propen-1-yl] amino|                      |           |                       |            |
|     | butyl]amino[propyl]-2-propenamide             |                      |           |                       |            |
| 471 | Aurantiamide acetate                           | \(S. \)torvum       | Aerial    |                       | [524]      |
| 472 | \(N\),\(N\),\(N\)-Tris(dihydrocaffeoyl) | \(S. \)sessiliflorum| Fruit    |                       | [525]      |
|     | spermidine                                     |                      |           |                       |            |
| 473 | \(N\)-(4-Aminobutyl)-N-[3-[[4-[(3,4-     | \(S. \)sessiliflorum| Fruit    |                       | [525]      |
|     | dihydroxyphenyl)-1-oxopropyl] amino|                      |           |                       |            |
|     | propyl]-3,4-dihydroxybenzenepropanamide        |                      |           |                       |            |
| 474 | \(N\)-(3-Aminopropyl)-N-[4-[[3-(3,4-     | \(S. \)sessiliflorum| Fruit    |                       | [525]      |
|     | dihydroxyphenyl)-1-oxopropyl] amino|                      |           |                       |            |
|     | butyl]-3,4-dihydroxybenzenepropanamide        |                      |           |                       |            |
| 475 | Soya-cerebroside I                             | \(S. \)torvum       | Root      |                       | [435]      |
|     | Sterols                                        |                      |           |                       |            |
| 476 | Cilistol G                                     | \(S. \)capsicoides  | Leaf      |                       | [85]       |
| 477 | Capsisteroid A                                 | \(S. \)capsicoides  | Leaf      |                       | [85]       |
| 478 | Capsisteroid B                                 | \(S. \)capsicoides  | Leaf      |                       | [85]       |
| 479 | Capsisteroid C                                 | \(S. \)capsicoides  | Leaf      |                       | [85]       |
| 480 | Capsisteroid D                                 | \(S. \)capsicoides  | Leaf      |                       | [85]       |
| 481 | Capsisteroid E                                 | \(S. \)capsicoides  | Leaf      |                       | [85]       |
| 482 | Capsisteroid F                                 | \(S. \)capsicoides  | Leaf      |                       | [85]       |
| 483 | \(\beta\)-Sitosterol                           | \(S. \)cathayanum   | Stem      |                       | [477, 522] |
|     |                                                | \(S. \)anguvi        | Fruit     |                       | [34]       |
|     |                                                | \(S. \)cornifolium   | Aerial    |                       | [472, 473] |
|     |                                                | \(S. \)dulcamara     | Fruit     |                       | [130]      |
|     |                                                | \(S. \)elaeagnifolium| Whole     |                       | [134, 504] |
|     |                                                | \(S. \)indicum       | Whole     |                       | [160]      |
|     |                                                | \(S. \)lycopersicum  | Seed      |                       | [478]      |
|     |                                                | \(S. \)melongena     | Aerial    |                       | [206, 439] |
|     |                                                | \(S. \)schimperianum | Aerial    |                       | [278]      |
|     |                                                | \(S. \)surattense    | Aerial    |                       | [518]      |
|     |                                                | \(S. \)torvum        | Root      |                       | [526]      |
|     |                                                | \(S. \)trilobatum    | Whole     |                       | [356]      |
|     |                                                | \(S. \)xanthocarpum  | Fruit     |                       | [398]      |
Table 2 (continued)

| No. | Compounds               | Plant sources | Parts       | Biological properties | References |
|-----|-------------------------|---------------|-------------|-----------------------|------------|
| 484 | Daucosterol             | *S. cathayanum* | Stem        |                       | [522]      |
|     |                         | *S. chrysochrichum* | Leaf       |                       | [120]      |
|     |                         | *S. elaeagnifolium* | Whole      |                       | [504]      |
|     |                         | *S. glabratum*     | Whole       |                       | [140]      |
|     |                         | *S. ligustrinum*    | Whole       |                       | [179]      |
|     |                         | *S. septemlobum*    | Aerial      |                       | [523]      |
|     |                         | *S. torvum*        | Root        |                       | [526]      |
|     |                         | *S. violaceum*     | Whole       |                       | [392]      |
| 485 | Campesterol             | *S. elaeagnifolium* | Seed       |                       | [134]      |
|     |                         | *S. melongena*     | Root        |                       | [439]      |
| 486 | Cholesterol             | *S. lycopersicum*  | Seed        |                       | [478]      |
|     |                         | *S. sessiliflorum*  | Fruit       |                       | [285]      |
| 487 | \(\gamma\)-Sitosterol   | *S. lycopersicum*  | Seed        |                       | [478]      |
| 488 | 7-Oxostigmasterol       | *S. violaceum*     | Aerial      |                       | [391]      |
| 489 | (3\(\beta\))-7-Hydroxystigmast-5-en-3-yl \(\beta\)-\(\alpha\)-glucoside | *S. violaceum*     | Whole       |                       | [392]      |
| 490 | Stigmasterol            | *S. cornifolium*   | Aerial      |                       | [472, 473] |
|     |                         | *S. dulcamara*     | Fruit       |                       | [130]      |
|     |                         | *S. elaeagnifolium* | Whole      |                       | [134, 504] |
|     |                         | *S. lycopersicum*  | Seed        |                       | [478]      |
|     |                         | *S. melongena*     | Aerial      |                       | [439]      |
|     |                         | *S. septemlobum*    | Aerial      |                       | [523]      |
|     |                         | *S. surattense*     | Aerial      |                       | [527]      |
|     |                         | *S. xanthocarpum*   | Fruit       |                       | [398]      |
| 491 | Brassicasterol          | *S. elaeagnifolium* | Seed       |                       | [134]      |
| 492 | Poriferasterol monoglucoside | *S. glabratum*     | Whole       |                       | [140]      |
| 493 | 7-Oxostigmasterol       | *S. violaceum*     | Aerial      |                       | [391]      |
| 494 | \(\beta\)-stigmasteryl-3-\(\alpha\)-\(\alpha\)-6-palmityl) glucoside | *S. septemlobum*    | Aerial      |                       | [523]      |
| 495 | Clerosterol             | *S. elaeagnifolium* | Seed       |                       | [134]      |
| 496 | 7-Sitoster-3\(\beta\)-ol | *S. elaeagnifolium* | Seed       |                       | [134]      |
| 497 | (3\(\beta\),5\(\alpha\))Cholest-7-en-3-ol | *S. lycopersicum*  | Seed        |                       | [478]      |
| 498 | Stigmasta-5,24(28)-dien-3-ol | *S. elaeagnifolium* | Seed       |                       | [134]      |
|     |                         | *S. torvum*        | Leaf        |                       | [318]      |
| 499 | Avenasterol             | *S. elaeagnifolium* | Seed       |                       | [134]      |
| 500 | 5,24-Stigmastadienol    | *S. elaeagnifolium* | Seed       |                       | [134]      |
| 501 | \(\gamma\)-Tocopherol   | *S. lycopersicum*  | Seed        |                       | [478]      |
|     |                         | *S. villosum*      | Leaf        |                       | [479]      |
| 502 | Ergosterol              | *S. lycopersicum*  | Seed        |                       | [478]      |
| 503 | Lanosterol              | *S. lycopersicum*  | Seed        |                       | [478]      |
| 504 | Peroxyergosterol        | *S. lyratum*       | Stem        |                       | [486]      |
|     |                         | *S. violaceum*     | Aerial      |                       | [391]      |
| 505 | 9,11-Dehydroergosterol peroxide | *S. lyratum*       | Stem        |                       | [486]      |
|     |                         | *S. violaceum*     | Aerial      |                       | [391]      |
| 506 | Nigralenostenone        | *S. nigrum*        | Leaf        |                       | [528]      |
| 507 | Tumacone A              | *S. nudum*         | Leaf        |                       | [242, 247] |
| 508 | Tumacone B              | *S. nudum*         | Leaf        |                       | [242, 247] |
| 509 | Tumacoside A            | *S. nudum*         | Leaf        | Antiplasmodial        | [242, 247] |
| 510 | Tumacoside B            | *S. nudum*         | Leaf        | Antiplasmodial        | [242, 247] |
| 511 | SN-1                    | *S. nudum*         | Aerial      | Antiplasmodial        | [245]      |
Table 2 (continued)

| No. | Compounds | Plant sources | Parts | Biological properties                  | References |
|-----|-----------|---------------|-------|----------------------------------------|------------|
| 512 | SN-2      | *S. nudum*    | Aerial | Antiplasmodial                          | [245]      |
| 513 | SN-3      | *S. nudum*    | Aerial | Antiplasmodial                          | [245]      |
| 514 | SN-4      | *S. nudum*    | Aerial | Antiplasmodial                          | [245]      |
| 515 | SN-5      | *S. nudum*    | Aerial | Antiplasmodial                          | [245]      |
| 516 | 9α,11α-epidioxyergosta-6,22-dien-3β-ol | *S. septemlobum* | Aerial |                                          | [523]      |
| 517 | Carpesterol | *S. capsicoides* | Seed  | Anticancer, antifungal                  | [86]       |
|     |           | *S. sevumbrifolium* |       |                                         | [519]      |
| 518 | Carpesterol methyl ether | *S. xanthocarpum* | Fruit | Antifungal                              | [401]      |
| 519 | Carpesterol ethyl ether | *S. xanthocarpum* | Fruit | Antifungal                              | [401]      |
| 520 | Stigmast-7-en-6-one, 3β-β-d-glucosyloxy)22-hydroxy-4-methyl-(3β,4α,5α,22R) | *S. xanthocarpum* | Fruit | Antifungal                              | [401]      |
| 521 | Stigmast-7-en-6-one, 3β-β-d-glucosyloxy)22-methoxy-4-methyl-(3β,4α,5α,22R) | *S. xanthocarpum* | Fruit | Antifungal                              | [401]      |
| 522 | Toptroil   | *S. glaucophyllum* | Leaf  |                                        | [529]      |
| 523 | Cholecalciferol | *S. glaucophyllum* | Leaf  |                                        | [530]      |
| 524 | β-β-d-Glucoside, (1α,3β,5Z,7E)-3,25-dihydroxy-9,10-secocholest-5,7,10(19)-trien-1-yl | *S. glaucophyllum* | Leaf  |                                        | [530]      |
| 525 | Dehydrocholesterol |                     |       |                                        |            |
| 526 | 3,4-Dihydro-3,5,8-trimethyl-3-(4,8,12-trimethyltridecyl)-2H-1-benzopyran-7-yl acetate | *S. villosum* | Leaf  |                                        | [479]      |
| 527 | Tumaquenone | *S. nudum*    | Aerial |                                        | [247]      |
| 528 | Abutiloside A | *S. abutiloides* | Root  |                                        | [5, 7–9]   |
| 529 | Abutiloside B | *S. abutiloides* | Root  |                                        | [5]        |
| 530 | Abutiloside H | *S. abutiloides* | Root  |                                        | [5]        |
| 531 | Abutiloside I | *S. abutiloides* | Root  |                                        | [5]        |
| 532 | Abutiloside J | *S. abutiloides* | Root  |                                        | [5]        |
| 533 | Abutiloside K | *S. abutiloides* | Root  |                                        | [5]        |
| 534 | Abutiloside C | *S. abutiloides* | Root  |                                        | [7, 8]     |
| 535 | Abutiloside D | *S. abutiloides* | Root  |                                        | [6]        |
| 536 | Abutiloside E | *S. abutiloides* | Root  |                                        | [6]        |
| 537 | Abutiloside F | *S. abutiloides* | Root  |                                        | [6]        |
| 538 | Abutiloside G | *S. abutiloides* | Root  |                                        | [6]        |
| 539 | Aethioside A | *S. aethiopicum* | Stem  |                                        | [28]       |
| 540 | Aethioside B | *S. aethiopicum* | Stem  |                                        | [28]       |
| 541 | Aethioside C | *S. aethiopicum* | Stem  |                                        | [28]       |

*Phenolic compounds*

| 542 | 4-Caffeoylquinic acid | *S. melongena* | Stem, Leaf |                                      | [205, 531] |
| 543 | 5-Caffeoylquinic acid | *S. lyratum* | Whole      |                                      | [517]      |
| 544 | (1R,3R,4S,5R)-3-(Acetyloxy)-5-[[2(E)-3-(3,4-dihydroxyphenyl)-1-oxo-2-propen-1-yl]oxy]-1,4-dihydroxycyclohexanecarboxylic acid | *S. melongena* | Stem |                                      | [205]      |
| 545 | (1S,3R,4R,5R)-3-(Acetyloxy)-4-[[2(E)-3-(3,4-dihydroxyphenyl)-1-oxo-2-propen-1-yl]oxy]-1,5-dihydroxycyclohexanecarboxylic acid | *S. melongena* | Stem |                                      | [205]      |
# Table 2 (continued)

| No. | Compounds               | Plant sources | Parts         | Biological properties | References |
|-----|-------------------------|---------------|---------------|-----------------------|------------|
| 546 | Chlorogenic acid        | *S. anguvi*   | Fruit         | Anticancer            | [31]       |
|     |                         | *S. guaraniticum* | Leaf         |                       | [146]      |
|     |                         | *S. incanum*  | Aerial        |                       | [494]      |
|     |                         | *S. lycocarpum* | Fruit        |                       | [532]      |
|     |                         | *S. lyratum*  | Whole         |                       | [517]      |
|     |                         | *S. melongena* | Stem,Leaf    |                       | [205, 531] |
|     |                         | *S. surattense* | Whole       |                       | [99]       |
| 547 | Neochlorogenic acid     | *S. lyratum*  | Whole         |                       | [517]      |
| 548 | Rosmarinic acid         | *S. betaceum* | Fruit         |                       | [78]       |
|     |                         | *S. guaraniticum* | Leaf         |                       | [146]      |
| 549 | 3,5-Dicaffeoylquinic acid | *S. melongena* | Stem         |                       | [91]       |
| 550 | (Z)-Neochlorogenic acid | *S. melongena* | Stem         |                       | [91]       |
| 551 | Gallic acid             | *S. anguvi*   | Fruit         | Anticancer            | [31]       |
|     |                         | *S. cernuum*  | Leaf          |                       | [112]      |
|     |                         | *S. spirale*  | Aerial        |                       | [299]      |
|     |                         | *S. surattense* | Whole       |                       | [99]       |
| 552 | 4-hydroxybenzoic acid   | *S. crinitum* | Fruit         |                       | [122]      |
|     |                         | *S. americanum* | Aerial      |                       | [49]       |
| 553 | Protocatechuic acid     | *S. lyratum*  | Whole         |                       | [514]      |
|     |                         | *S. spirale*  | Leaf          |                       | [297]      |
|     |                         | *S. nigrum*   | Whole         |                       | [520]      |
| 554 | Vanillic acid           | *S. lyratum*  | Whole         |                       | [514]      |
|     |                         | *S. sessiliflorum* | Fruit    |                       | [510]      |
|     |                         | *S. nigrum*   | Whole         |                       | [520]      |
|     |                         | *S. vestissimum* | Fruit     |                       | [491]      |
| 555 | Caffeic acid            | *S. anguvi*   | Fruit         | Anticancer            | [31]       |
|     |                         | *S. guaraniticum* | Leaf         |                       | [146]      |
|     |                         | *S. incanum*  | Aerial        |                       | [506]      |
|     |                         | *S. lycocarpum* | Fruit        |                       | [532]      |
|     |                         | *S. lyratum*  | Whole         |                       | [194]      |
|     |                         | *S. melongena* | Stem         |                       | [205]      |
|     |                         | *S. maricatum* | Whole        |                       | [215]      |
|     |                         | *S. surattense* | Whole       |                       | [99, 518] |
|     |                         | *S. xanthocarpum* | Root      |                       | [427]      |
| 556 | *P*-Coumaric acid       | *S. americanum* | Aerial      |                       | [49]       |
| 557 | Isoferulic acid         | *S. cernuum*  | Leaf          |                       | [109, 112] |
| 558 | 2,4,6-Trimethoxyphenol  | *S. torvum*   | Stem          |                       | [533]      |
| 559 | Propionylsyringol       | *S. torvum*   | Stem          |                       | [533]      |
| 560 | Resveratrol             | *S. americanum* | Fruit      |                       | [45]       |
| 561 | *cis*-p-Coumaric acid ethyl ester | *S. crinitum* | Fruit         |                       | [122]      |
| 562 | *cis*-p-Coumaric acid   | *S. crinitum* | Fruit         |                       | [122]      |
| 563 | *trans*-p-Coumaric acid ethyl ester | *S. crinitum* | Fruit         |                       | [122]      |
| 564 | *trans*-p-Coumaric acid | *S. crinitum* | Fruit         |                       | [122]      |
|     |                         | *S. incanum*  | Aerial        |                       | [506]      |
| 565 | Erythro-1,2-bis-(4-hydroxy-3-methoxyphenyl)-1,3-propanediol | *S. lyratum* | Whole         |                       | [517]      |
| 566 | Threo-1,2-bis-(4-hydroxy-3-methoxyphenyl)-1,3-propanediol | *S. lyratum* | Whole         |                       | [517]      |
| 567 | Evofolin B              | *S. surattense* | Whole       |                       | [518]      |
| 568 | Ethyl caffeate          | *S. nienkui*  | Whole         |                       | [509]      |
Table 2 (continued)

| No. | Compounds                        | Plant sources       | Parts         | Biological properties                  | References |
|-----|----------------------------------|---------------------|---------------|----------------------------------------|------------|
| 569 | Methyl salicylate                | S. nienkui          | Whole         |                                        | [509]      |
| 570 | p-Hydroxybenzoic acid            | S. nigrastrum       | Leaf          |                                        | [11]       |
| 571 | Vanillin                         | S. nienkui          | Whole         |                                        | [509]      |
| 572 | Protocatechuic aldehyde          | S. nienkui          | Whole         |                                        | [509]      |
| 573 | 3,5-Diethoxyphenol               | S. nigrastrum       | Leaf          |                                        | [528]      |
| 574 | Quinic acid                      | S. sessiliflorum    | Fruit         |                                        | [525]      |
| 575 | Phenol                           | S. sessiliflorum    | Fruit         |                                        | [525]      |
| 576 | Salicylic acid                   | S. torvum           | Aerial        |                                        | [524]      |
| 577 | Violaxanthin                     | S. sessiliflorum    | Fruit         |                                        | [525]      |
| 578 | Lutein                           | S. sessiliflorum    | Fruit         |                                        | [525]      |
| 579 | α-Carotene                       | S. sessiliflorum    | Fruit         |                                        | [525]      |
| 580 | Kryptoxanthin                    | S. sessiliflorum    | Fruit         |                                        | [525]      |
| 581 | Luteoxanthin                     | S. sessiliflorum    | Fruit         |                                        | [525]      |
| 582 | 15-cis-β-Carotene                | S. sessiliflorum    | Fruit         |                                        | [525]      |
| 583 | Folioxanthin                     | S. sessiliflorum    | Fruit         |                                        | [525]      |
| 584 | Physoxanthin                     | S. sessiliflorum    | Fruit         |                                        | [525]      |
| 585 | Coniferol                        | S. surattense       | Whole         |                                        | [518]      |
| 586 | 1,2-Bis(4-hydroxy-3-methoxyphenyl)-1,3-propanediol | S. surattense | Whole |                                        | [518]      |
| 587 | Threo-1-(4-Hydroxy-3-methoxyphenyl)-2-[[4-[(E)-3-hydroxy-1-propenyl]-2-methoxy phenox]-1,3-propanediol | S. surattense | Whole |                                        | [518]      |
| 588 | Tyrosol C                        | S. validinervium    | Aerial        |                                        | [534]      |
| 589 | (E)-Coniferaldehyde              | S. melongena        | Root          |                                        | [209]      |
| 590 | trans-Cinnamic acid              | S. spirale          | Leaf          | Antibacterial                          | [297]      |
| 591 | Methyl caffeate                  | S. torvum           | Fruit         | Antibacterial, antidiabetic            | [315, 320, 335–337] |
| 592 | (E)-2,3-dihydroxycyclopentyl-3-(3',4'-dihydroxyphenyl)acrylate | S. torvum | Fruit | Antihypertensive                      | [521]      |
| 593 | Eugenol                          | S. torvum           | Stem          |                                        | [533]      |
| 594 | Scopolin                         | S. cathayanum       | Stem          | Anticancer                             | [104, 105] |
| 595 | Scopoletin                       | S. lyrum            | Whole         |                                        | [194]      |
| 596 | Coumarin                         | S. glutatum         | Whole         |                                        | [140]      |
| 597 | Fraxetin                         | S. indicum          | Seed          |                                        | [535]      |
| 598 | Isofraxidin                      | S. indicum          | Seed          |                                        | [536]      |
| 599 | Umbelliferone                    | S. lycopersicum     | Aerial        |                                        | [438]      |
| 600 | 7-hydroxy-6,8-dimethoxy-3-(4’-hydroxy-3’-methoxyphenyl)-coumarin | S. indicum | Seed |                                        | [536]      |
| 601 | Cleosandrin                      | S. indicum          | Seed          |                                        | [535]      |
| 602 | 4,4’-Biisofraxidin               | S. indicum          | Seed          |                                        | [535]      |
| 603 | Arteminorin A                    | S. indicum          | Seed          |                                        | [535]      |
| 604 | Indicumin E                      | S. indicum          | Seed          |                                        | [536]      |
| 605 | Bergaptin                        | S. lycopersicum     | Aerial        |                                        | [438]      |
Table 2 (continued)

| No. | Compounds                          | Plant sources          | Parts       | Biological properties         | References   |
|-----|------------------------------------|------------------------|-------------|-------------------------------|--------------|
| 606 | Aesculetin                          | S. lycopersicum        | Aerial      |                               | [438]        |
|     |                                    | S. validinervium       | Aerial      |                               | [534, 537]   |
| 607 | 6, 7-Dimethoxycoumarin              | S. melongena           | Root        |                               | [209]        |
| 608 | Escopoletin                         | S. nigrum              | Whole       |                               | [520]        |
| 609 | Isosopoletin                        | S. validinervium       | Aerial      |                               | [534, 537]   |
| 610 | 1′-O-7-esculetin-4′-O-1′-ethylenglycol-β- | S. validinervium       | Aerial      |                               | [534]        |
|     | n-glucose                           |                        |             |                               |              |
| 611 | Coumestrol                          | S. lyratum             | Whole       | Anti-inflammatory             | [88]         |
| 612 | 9-hydroxy-2′,2′-dimethyl[5′,6′:2,3]-counestan | S. lyratum             | Whole       | Anti-inflammatory             | [88]         |
| 613 | Solalyratin A                       | S. lyratum             | Whole       | Anti-inflammatory             | [88]         |
|     | Coumarinolignoids                   |                        |             |                               |              |
| 614 | Indicumine A                        | S. indicum             | Seed        | Anti-HBV                      | [535]        |
| 615 | Indicumine B                        | S. indicum             | Seed        | Anti-HBV                      | [535]        |
| 616 | Indicumine C                        | S. indicum             | Seed        |                               | [535]        |
| 617 | Indicumine D                        | S. indicum             | Seed        |                               | [535]        |
|     | Fatty acids and esters              |                        |             |                               |              |
| 618 | Hexadecanoic acid                   | S. aculeastrum         | Leaf        |                               | [11]         |
|     |                                    | S. vestissimum         | Fruit       |                               | [490]        |
|     |                                    | S. villosum            | Leaf        |                               | [434, 479]   |
| 619 | Octadecanoic acid,                  | S. aculeastrum         | Leaf        |                               | [11]         |
|     |                                    | S. erianthum           | Leaf        |                               | [137]        |
| 620 | Linoleic acid                       | S. aculeastrum         | Leaf        |                               | [11]         |
|     |                                    | S. glabratum           | Whole       |                               | [140]        |
| 621 | Lignoceric acid                     | S. cathayanum          | Stem        |                               | [477]        |
| 622 | Corchorifatty acid B                | S. americanum          | Aerial      |                               | [49]         |
| 623 | Linolenic acid                      | S. erianthum           | Leaf        |                               | [137]        |
|     |                                    | S. glabratum           | Whole       |                               | [140]        |
| 624 | 9(Z),11(E)-Octadecadienoic acid     | S. erianthum           | Leaf        |                               | [137]        |
| 625 | 13S-Hydroxy-9(Z),11(E)-octadecadienoic acid | S. erianthum           | Leaf        |                               | [137]        |
| 626 | 9S-Hydroxy-10(E),12(Z),15(Z)-octadecatrienoic acid | S. erianthum           | Leaf        |                               | [137]        |
| 627 | Decosahexaenoic acid                | S. glabratum           | Whole       |                               | [140]        |
| 628 | Decosapentaenoic acid               | S. glabratum           | Whole       |                               | [140]        |
| 629 | Oleic acid                          | S. glabratum           | Whole       |                               | [140]        |
| 630 | Eicosapentaenoic acid               | S. glabratum           | Whole       |                               | [140]        |
| 631 | Lauric acid                         | S. glabratum           | Whole       |                               | [140]        |
| 632 | Palmitoleic acid                    | S. glabratum           | Whole       |                               | [140]        |
| 633 | Arachidonic acid                    | S. glabratum           | Whole       |                               | [140]        |
|     |                                    | S. trilobatum          | Whole       |                               | [356]        |
| 634 | Myristic acid                       | S. glabratum           | Whole       |                               | [140]        |
| 635 | Gamma-linolenic acid                | S. glabratum           | Whole       |                               | [140]        |
| 636 | 9-Oxo-(10E, 12Z)-octadecadienoic acid | S. melongena           | Calyx       |                               | [91]         |
| 637 | (10Z,12E)-9-Oxo-10,12-octadecadienoic acid | S. melongena           | Calyx       |                               | [91]         |
| 638 | Eicosanoic acid                     | S. torvum              | Root        |                               | [526]        |
| 639 | Octacosanoic acid                   | S. torvum              | Root        |                               | [526]        |
| 640 | 4-(3,5-Di-Tert-Butyl-4-Hydroxy Phenyl)butyl Acrylate | S. villosum           | Leaf        |                               | [479]        |
An avenacoside-type saponin (51) was isolated from aerial parts of *S. surattense* [305]. Two 23-keto-spirostanol glycosides, torvoside Q (18) and paniculonin B (126) were obtained from aerial parts of *S. torvum* [323, 331]. Torvosides A (64), B (65), F (67) and G (112) displayed a positive reaction with Ehrlich reagent, suggesting these to be furostanol glycosides [449]. Abutilosides L (106), M (107) and N (108), a 22S,25S-epoxy-furost-5-ene type glycosides, and abutiloside O, being a 20,22-seco-type steroidal glycoside, were isolated from the fresh fruits of *S. abutiloides* [4].

Anguiviosides III (118) and XI (119) are hydroxylated at C-23 and C-26 on the spirostanol and furostanol skeletons, resp. Anguiviosides XV (120) and XVI (121) are based on a 16, 22-dicarboxyl aglycon, with 121 hydroxylated at C-23 and C-26 followed by ring closure. The biogenetic pathway of 16,22-dicarbonyl compounds such as 120 and 121 might be considered via a 17R-hydroxy spirostanol such as pentogenin, 11 or via a 3β,16β,22,26-tetrahydroxycholesterol glycoside such as anguivioside A (114) [43].

*Solanum* saponins were reported to have various bioactivities, e.g. cytotoxic [257], anticancer [316, 317, 392], hepatoprotective [242, 247], antihypertensive [289, 291], antimelanogenesis [211], antifungal [113, 114, 117], anti-inflammatory [331, 392, 448] anticonvulsant [305] and antiviral [257].

| No. | Compounds                  | Plant sources | Parts         | Biological properties       | References  |
|-----|----------------------------|---------------|---------------|-----------------------------|-------------|
| 641 | Puerariafuran              | *S. lyratum*  | Whole         | Anti-inflammatory           | [88]        |
| 642 | 1,2-Benzenedicarboxylic acid | *S. aculeastrum* | Leaf         |                             | [11]        |
| 643 | 1, 4-Dimethyl-benzene      | *S. aculeastrum* | Leaf         |                             | [11]        |
| 644 | n-Nonane                   | *S. aculeastrum* | Leaf         |                             | [11]        |
| 645 | n-Octanol                  | *S. aculeastrum* | Leaf         |                             | [11]        |
| 646 | Methyl hexadecanoate       | *S. aculeastrum* | Leaf         |                             | [11]        |
| 647 | Dodecane                   | *S. aculeastrum* | Leaf         |                             | [11]        |
| 648 | Undecanol                  | *S. aculeastrum* | Leaf         |                             | [11]        |
| 649 | Nonanal                     | *S. aculeastrum* | Leaf         |                             | [11]        |
| 650 | Eicosane                    | *S. aculeastrum* | Leaf         |                             | [11]        |
|     |                             | *S. betaceum*  | Fruit        |                             | [77]        |
| 651 | Methyl-9,12-octadecadienoate | *S. aculeastrum* | Leaf         |                             | [11]        |
| 652 | Hexadecane                 | *S. aculeastrum* | Leaf         |                             | [11]        |
| 653 | 9,17-Octadecadienal        | *S. aculeastrum* | Leaf         |                             | [11]        |
| 654 | Hexanal                    | *S. betaceum*  | Fruit        |                             | [78]        |
| 655 | Ethyl butanoate            | *S. betaceum*  | Fruit        |                             | [78]        |
| 656 | 4-Hydroxy-4-methyl-2-pentanone | *S. betaceum*    | Fruit        |                             | [78]        |
| 657 | 2,3-Butanediol             | *S. betaceum*  | Fruit        |                             | [78]        |
| 658 | cis-3-Hexen-1-ol           | *S. betaceum*  | Fruit        |                             | [78]        |
| 659 | 3(Z)-Hexenal               | *S. betaceum*  | Fruit        |                             | [78]        |
| 660 | Ethyl-α-l-arabinofuranoside | *S. lyratum*  | Whole        | Anti-inflammatory           | [514]       |
| 661 | Solalyratin B              | *S. lyratum*  | Whole        | Anti-inflammatory           | [514]       |
| 662 | 1-[1-[2-(2-hydroxypropoxy) propoxy] propan-2-yloxy] propan-2-ol | *S. schimperianum* | Aerial     |                             | [277]       |
| 663 | 5-Hydroxymethyl furfural   | *S. torvum*   | Stem         |                             | [533]       |
| 664 | Solanesol                  | *S. tuberosum* | Leaf         |                             | [538]       |
| 665 | 3-Hydroxymethyl-7-methoxywutaifuranol | *S. cathayanum* | Whole     |                             | [102]       |
| 666 | Phenylmethyl 2- O-β-d-xyllosyl-β-d-glucoside | *S. incanum* | Aerial     |                             | [506]       |
| 667 | Zizybeoside I              | *S. lycopersicum* | Fruit      |                             | [511]       |
| 668 | Methyl salicylate 2-O-β-d-glucosyl-(1-2)-[O-β-d-xyllosyl-(1-6)]-O-β-d-glucoside | *S. lycopersicum* | Fruit |                             | [511]       |
| 669 | Phenethyl alcohol 8-O-β-d-glucosyl-(1-2)-[O-α-l-arabinosyl-(1-6)]-O-β-d-glucoside | *S. lycopersicum* | Fruit |                             | [511]       |
| 670 | Benzyl alcohol 7-O-β-d-glucosyl-(1-2)-[O-α-l-arabinosyl-(1-6)]-β-d-glucoside | *S. lycopersicum* | Fruit |                             | [511]       |
Nuatigenosido (15) from the roots of *S. sisymbriifolium* presented anti-hypertensive effect in experimental hypertensive rats [291]. Dioscin (19) showed antimelanogenesis effect on α-melanocyte stimulating hormone (α-MSH) induced melanogenesis in B16 murine melanoma cells. It significantly downregulated the expression of tyrosinase, TRP-1, and TRP-2, which led to the reduction of α-MSH-induced melanogenesis in B16 cells [211]. Degraded
Fig. 1 (continued)
Fig. 1 (continued)
diosgenone (13) from *S. nudum* exhibited hepatoprotective effect on the liver of mice infected with *Plasmodium berghei*; necrosis of hepatocytes in mice infected with malaria decreased 47–65 [249].

Spirostanic saponins SC2-SC6 (36–40) from the leaves of *S. chrysotrichum* displayed activity against dermatophytes and yeasts. 36 was the most active in indicating fungicidal
effect against *Candida albicans* and non-albicans strains [113, 114, 117].

Indioside H (83), borassoside E (85), indioside I (86) and yamosicin (89) demonstrated cytotoxic activity against six human cancer cell lines (HepG2, Hep3B, A549, Ca9-22, MDA-MB-231, and MCF-7) (IC$_{50}$ = 1.83–8.04 μg/mL) [392]. Separately, 85 and 86 presented inflammation inhibitory effects on SAG (IC$_{50}$ = 0.62 ± 0.03 and 2.84 ± 0.18 μg/mL, resp.). Compound 85 also inhibited elastase release with IC$_{50}$ values of 111.05 ± 7.37 μg/mL [392], while 89 showed anti-neutrophilic inflammatory activity against SAG with an IC$_{50}$ value of 3.59 μM [331].

Torvosides N (8) and M (23) revealed significant cytotoxicity against MGC-803, HepG2, A549 and MCF-7 as compared to the positive control, CDDP [316]. Torvosides J-L (95–97), isolated from the leaves of *S. torvum*, exhibited substantial anticonvulsant activity in zebrafish seizure assays [323], while 96 also showed considerable antifungal activity against *Aspergillus flavus* and *Fusarium verticillioides* with MIC ranging from 31.25 to 250 μg/mL [318]. Compounds 99 and 100 inhibited both inflammatory mediators SAG (IC$_{50}$ = 3.49 and 2.87 μM) and elastase release (IC$_{50}$ = 2.69 and 0.66 μM) [331], while 123–125 convinced cytotoxicities against melanoma A375 [317].

### 3.2 Steroidal Alkaloids

Sixty-three steroidal alkaloids (135–197), as other principal components in *Solanum* were reported from this genus (Fig. 2). Compounds 139–156 are derivatives of solasodine (145), one of the main glycoalkaloid constituents in *Solanum* spp., even as indicated by several numbers of species from which it has been isolated. Solamargine (139) is the major steroidal alkaloid constituent of *Solanum* plants and literature data showed that it has been revealed in 18 species.

Compounds such as 139, solasoline (142), β1-solasoline (143) and solanigrosone P (156) with three sugar units and α-L-rhamnose at C-2 or a hydroxyl group on the steroidal backbone may be potential candidates for the treatment of gastric cancer [228].

Featured here are steroidal pseudoalkaloid oligoglycosides, robeneosides A (153) and B (154) and lobofrutoside (155) from the fruits of *S. lycocarpum* [182, 447], and a rare 16β-H steroidal alkaloid (157) from aerial parts of *S. suratense* [305]. Also included are leptine I (171) and II (172), the solanidine alkaloid glycosides, isolated from aerial parts of *S. orbignianum* [46].

Two rare C-3 amino steroidal alkaloids, 188 and 189, were isolated from aerial parts of *S. triste* [362, 471]. Three C-27 steroidal glycoalkaloids, spiralosides A (194), B (193), C (192), were obtained from the fruits of *S. spirale* [474]. Esculeoside A (197), a tomato saponin, is a significant component of ripened tomatoes isolated by Toshihiro et al. [475].

Various bioactivities e.g. antibacterial [80, 384, 403, 406, 407], anticancer [13, 305, 458], antidiabetic [182, 183], antifungal [279], anti-inflammatory [303], CNS depressant [294], leishmanicidal [182, 183], molluscicidal [384, 403, 406, 407], neurototoxicity [106], schistosomicidal [185, 186, 447, 457], spasmolytic [70] and trypanocidal [185, 186, 447, 457] were highlighted as have been exhibited by steroidal alkaloids of *Solanum*.

Antioxidant activity of 145 and tomatidine (167) from the berries of *S. aculeastrum* was investigated using DPPH, ABTS and reducing power assays, and the highest inhibition was observed when the two compounds were combined, followed by 145 and 167 [13]. Furthermore, 145 exhibited significant anti-inflammatory activity at doses of 30 mg/kg, with a maximum inhibition of 77.75% in carrageenan-induced rat paw edema, comparing to indomethacin (81.69%). It also showed stronger (46.79% effect in xylene induced ear edema in mice [303]. Intraperitoneal injection of 145 (25 mg/kg) significantly delayed latency of hind limb tonic extensor phase in the picrotoxin-induced convulsions, and it also potentiated thiopental-provoked sleep in a dose-dependent manner [294]. Moreover, 145 exhibited not only the antibacterial activity against *Klebsiella* and *Staphylococcus* spp. at concentration of 1 mg, together with 139 and 141 [403], but also a potent stemness and invasion inhibitory effect on human colorectal cancer HCT116 cells [155]. Colony Spheroid formation assay showed that solasodine dose-dependently prohibited HCT116 cell stemness. CD133, CD44, Nanog, Oct-4 and Sox-2 were inhibited by 145 to reverse stemness and similar mechanism was stimulated in vivo. Transwell and scratch wound assays revealed that 145 impeded HCT116 cell invasion and migration potential strengthened by TGF-β1. Moreover, solasodine attenuated TGF-β1-induced EMT and decreased MMPs while in vivo study showed the same trend. The results of this study implied that 145 may be a novel therapeutic drug for CRC treatment [155].

Burger et al. documented that the crude extract and aqueous fraction containing 139 displayed potent non-selective cytotoxicity (IC$_{50}$ 15.62 μM) and noteworthy 9.1-fold P-glycoprotein inhibition at 100 μg/mL [15]. Zhang et al. assessed the molecular mechanism underlying the anti-cancer effect of 139 in human cholangiocarcinoma QBC939 cells. The results revealed that 139 inhibited the viability of QBC939 cells in a dose-dependent manner. Furthermore, it significantly induced the apoptosis of QBC939 cells and altered the mitochondrial membrane potential of cells. Quantitative polymerase chain reaction analysis revealed that 139 decreased the mRNA level of B cell lymphoma-2 (Bcl-2) Bcl-extra-large and X-linked inhibitor of apoptosis protein but increased the mRNA level of Bcl-2-associated X protein (Bax) In addition,
western blot analysis demonstrated that 139 inhibited the protein expression of Bcl-2 and poly ADP ribose polymerase (PARP) and promoted the protein expression of Bax, cleaved PARP, caspase 3, cleaved caspase 3 and caspase [97].

Compounds 139, 141 and 157 demonstrated cytotoxicity against A549, whereas 139 and 156 showed cytotoxicity against HepG2 cell lines [305]. Compounds 139 and 141 were confirmed as the effective components for *Oncomelania* snail control. The death rate of *Oncomelania* snails was 94.2 at a concentration of 2.50 mg/L (139) [406], while 141
exhibited a lethality of 100% against *O. hupensis* [407]. Moreover, 139 and solasonine (142) displayed not only leishmanicidal activity against promastigote forms of *Leishmania amazonensis* [185], but also antidiabetic activity by inhibiting the serum glucose increase in oral sucrose-loaded rats and suppressing gastric emptying in mice [182]. A synergistic effect was observed for a mixture of the compounds [183]. Compound 139 also expressed stronger trypanocidal activity (IC₅₀ = 15.3 μg/mL), when compared to benznidazole (IC₅₀ = 9.0 μg/mL), the only drug used to treat Chagas’ disease [186].

Tomatine (168) was illustrated to exert significant neuroprotective effect on H₂O₂-induced SH-SY5Y cells, by enhancing intracellular anti-oxidant enzyme activity and brain-derived neurotrophic factor expression and restraining H₂O₂-induced oxidative stress [106]. Isojuripidine (190) displayed spasmolytic activity by hindering phasic contractions induced by both histamine and acetylcholine in guinea-pig ileum [69].

### 3.3 Pregnane Glycosides

Compounds 198–210 from *Solanum* comprise pregnane glycosides (Fig. 3). These compounds coexist in small amounts and could be biosynthesised from steroidal glycosides [194]. Solanigrosides A (198), B (199), 200 and hypoglaucin H (202) were isolated from *S. nigrum* [476]. Aerial parts of *S. torvum* gave the highest number of pregnane glycosides, torvpregnanosides A (205) and B (207), ganaxolone (208), allopregnanolone (209) and pregnanolone (210). The whole plant of *S. lyratum* afforded compounds 203 and 204 [194].

Pregnane glycosides have reportedly demonstrated anti-cancer properties [194, 317]. Compound 203 exhibited substantial cytotoxic activity against A375-S2, HeLa, SGC-7901, and Bel-7402 cell lines, with IC₅₀ values of 13.1 to 49.8 μg/mL [194]. Compound 206 indicated cytotoxicity against human melanoma A375 (IC₅₀ = 39.66 μM) [317].
3.4 Triterpenes

Fourteen triterpenes (211–224) were identified in Solanum spp. (Figure 4), with lupeol (212) from S. cathanum [472, 473, 477], S. schimperianum [278], S. spirale [297] and ursolic acid (216) from S. lyratum [197], S. torvum [463] and S. xanthocarpum [427], as the major ones. Six triterpenes (216–217 and 221–224) were reported from the aerial parts of S. torvum [314, 463]. Two cycloartane triterpenoids, cycloeucalenone (213) and 24-oxo-31-norcycloartanone (214) are the main constituents of S. cernuum leaves [107]. Daturaolone (218) was isolated for the first time from S. arundo [65].

Solanum triterpenes have indicated to possess anti-cancer properties. For instance, 213 presented significant activity against KB-Oral cavity cancer (IC50 = 26.73 μg/mL) [297], while 213 exhibited selective activity against lung tumor cell line (NCIH460). The anti-nociceptive activity observed for 213 and 214 was found to be related to the inhibition of different mediators involved in inflammation and nociceptive process. Both compounds decreased cyclooxygenase 2 (COX-2) protein expression, although only 214 reached a significant response (P < 0.05 vs control) [107].

3.5 Diterpenes

Four diterpenes, e.g., phytol (225) from S. pseudocapsicum [263], kaur-16-ene (226) from S. aculeastrum [11], solanerioside A (227) from S. erianthum [138], and tricalysioside U (228) from S. violaceum [392] were reported from Solanum spp. (Figure 5). Solanerioside A (227) was the first example of a diterpenoid glucoside featuring a 14, 15-dinor-cyclophytane scaffold [138].

3.6 Sesquiterpenes

Sesquiterpenes, 229–310, have been characterized from Solanum spp. (Figure 6). Majority of these compounds, 260–282, were from S. lyratum [196, 197, 199, 200, 484–486] and S. septemlobum [281, 482, 483]. Likewise, 283–285 and 298–303 were reported from S. septemlobum [281, 482, 483]. Compounds 229–231 and 245–255 were isolated from the leaves and fruits of S. erianthum [138, 481], while 286–293 were from the roots of S. torvum [487]. Compounds 236–239 were isolated from the roots of S. aethiopicum [29], while 240–242 were obtained from the leaves of S. aculeastrum [11]. The fruits of S. betaceum yielded compounds 306–310 [77].

The bioactivities notably displayed by sesquiterpenes include anticancer [197–200, 281, 484] and antifungal [3]. 3-β-Hydroxysolavetivone (232), solavetivone (233) and lubimin (235) from the roots of S. abutiloides exhibited anti-fungal activities against Fusarium oxysporum f. sp. Melongenae [3]. The eudesmane-type, solajiangxin D (276), and vetispirane-type, solajiangxin E (277) from S. lyratum demonstrated crucial cytotoxicities (ED50 = 2.1–3.7 μg/mL) against three human cancer lines (P-388, HONE-1, and HT-29) [200]. Solajiangxin B (258), A (274) and C (275) from the whole plant of S. lyratum [198] and Septemlobin D (259), and 11,12-O-isopropyldene solajiangxin F (298) [483] also showed significant cytotoxicities (ED50 = 1.9–3.7, and 3.0–7.3 μM, resp.)
against these three cancer cell lines. Lyratol D (257), blumenol A (260), dehydrovomifoliol (262) and lyratol C (272) from the whole plant of *S. lyratum* displayed critical cytotoxic activities against HONE-1 nasopharyngeal, KB oral epidermoid carcinoma, and HT29 colorectal carcinoma cells (IC$_{50}$ = 3.7–8.1 μM) [199].

Eudesmane-related sesquiterpenes, septemlobins A (301) and B (302) and vetispirane-type, septemlobin C (303) exhibited significant cytotoxicities against three cancer cell lines (P-388, HONE-1, and HT-29) (IC$_{50}$ = 3.8–7.5 μM) [281].

### 3.7 Monoterpenes

Twenty-eight monoterpenes (311–338) have been characterized from *Solanum* spp. (Fig. 7), with β-Ionone (320) reported from *S. aculeastrum* [11], *S. pseudocapsicum* [263] and *S. betaceum* [77], and lolilide (323) obtained from *S. erianthum* [137], *S. americanum* [49] and *S. pseudocapsicum* [263], as dominant monoterpenes. Majority of the compounds, 316–318 and 324–333 [468, 489–492], were obtained from the fruits of *S. vestissimum*. Hotrienol (324), with very sweet and flowery flavor is a well-known constituent of the leaf oil of *Cinnamomum camphora*. It has also been found in a large number of other natural tissues, such as tea, grapes, wines passion fruit, elderberry flowers, *Achillea ligustica* and papaya fruit [468]. Seven monoterpenes, 311–313 and 319–322 were reported from the leaves of *S. aculeastrum* [11], and glycosides 329–332 were the aroma precursors in *S. vestissimum* fruit peelings [468, 492].

### 3.8 Flavonoids

Seventy-two flavonoids 339–413 have been identified in the genus *Solanum* (Fig. 8), with quercetin (340) and kaempferol (351) as the primary flavonoids. Several glycosylated flavonoids, e.g., afzelin (344), astragalin (346), kaempferol 3-O-[apiofuranosyl-(1 → 2)]- α-rhamnoside (347) and -β-galactoside (348) from *S. cernuum* [501], and cameliaside C (352) from *S. erianthum* [137] were obtained. Five kaempferol derivatives 373–377 were reported from *S. elaeagnifolium* [502]. Moreover, three anthocyanins 361–363 were isolated from the red and purple tubers of *S. tuberosum* [508], while five anthocyanin rutinosides 364–368 were reported from the fruits of *S. betaceum* [75, 76]. Anthocyanins are the largest group of water-soluble pigments in the plant kingdom. They are responsible for most red and blue colours in fruits, vegetables, and have been used in the food industry as pigments, owing to their bright attractive colours, high water solubility and
Fig. 5  Diterpenes 225–228 from Solanum

Fig. 6  Sesquiterpenes 229–310 from Solanum
associated health benefits [76]. In addition, diverse flavonoids, such as 388–397 from S. jabrense [167] and S. palodusum [513] and 399–403 from S. lyratum [514] were reported.

Flavonoids of Solanum have displayed various biactivities e.g., anticancer [31, 75, 76, 503], anti-depressant and antiviral [322, 332] and hepatoprotective [502] characteristics. Compound 373 exhibited significant hepatoprotective and curative effects against histopathological and histochimical damage induced by paracetamol in liver [502], while 349 and 371 displayed cytotoxicity against breast MCF7 and liver HPG2 cancer cell lines [503].

Compound 340 and rutin (342) indicated potent and concentration-dependent free radical-scavenging activity [45]. They also inhibited peroxidation of cerebral and hepatic lipids subjected to iron oxidative assault. Compound 340 induced in vitro antiproliferative and apoptotic activities on Jurkat cells (IC_{50} = 11.77 ± 2.4 mg/mL) [23], while 364-367 showed antioxidant activities [75]. Torvanol A (409) from the roots of S. torvum exhibited antidepressant, anxiolytic and adaptogenic effects [316], as well as anti-HSV-1 activity (IC_{50} = 9.6 μg/mL) [322].

3.9 Lignans

Lignans, widely distributed in the plant kingdom, are a family of secondary metabolites produced by oxidative dimerization of two phenylpropanoid units. Although their molecular scaffold consists only of two phenylpropane (C6–C3) units, lignans exhibit an enormous structural diversity originating from various linkage patterns of these phenylpropane units. As the C-8–C-3′/C-7–O–C-4′ linked lignans containing two chiral centers (C-7 and C-8) comprise the core of 2,3-dihydrobenzo[b]furan [480].

Lignans are rare in the genus Solanum [79], with only 31 compounds (414–444) having been isolated (Fig. 9). Compounds 414–419 were obtained from the stems of S. buddleiafolium [79], while 424–432, 434 and 442 were isolated from the roots of S. melongena [208–210]. Several neo-lignans, sisymbrifolin (433) from the fruits of S. sisimbriifolium.
ficusal (442) from the roots of S. melongena [209], glycosmic acid (439), simulanol (440) and balanophonin (443) from the whole plant of S. surattense [518] were identified. A pair of new C-8–C-3′/C-7–O–C-4′ linked neolignan enantiomers, 420 and 421, were isolated from the stems of S. erianthum [480]. Lignanamides 424–432 were obtained from the roots of S. melongena [210]. Among lignans from the genus Solanum, only lignanamides (425–432) were reported with bioactivities. They displayed anti-inflammatory activities by inhibition of nitric oxide production in lipopoly-saccharide-induced RAW 264.7 macrophages (IC50 = 16.2 to 58.5 μM) [210].

3.10 Other Alkaloids

The alkaloids have a natural (2-aminopyrrolidin-1-yl) carboxamidine alkaloidal base acylated with isoferulic (3-hydroxy-4-methoxycinnamic) acid with Z and E configurations, resp. [111]. Thirty-one alkaloids 445–475 have been isolated from Solanum spp. (Fig. 10), comprising types of cyclic guanidine alkaloids, e.g., cernumidine (446) and isocernumidine (447) from the leaves of S. cernuum [109, 111, 112]. Bioactive long chain amides, 454–456, exhibiting antimicrobial activity against Escherichia coli and Candida albicans were isolated from aerial parts of S. schimperianum [277]. Compounds 472–474 were obtained from S. sessiliflorum [525].

Antidiabetic activity was illustrated by Solanum alkaloids [49, 209]. Four amides, N-trans-p-coumaroyl -octopamine (465) and -tyramine (467) exhibited antidiabetic properties by enhancing α-glucosidase inhibitory activity in a study involving dual high-resolution α-glucosidase-radical scavenging inhibition profiling [35]. Moreover, 459, 466 and 468 demonstrated possession of inhibitory activity against α-glucosidase (IC50 = 500.6, 5.3 and 46.3 μM, resp.) [209].

3.11 Sterols

Sixty-six sterols (476–541) were obtained from the genus Solanum (Fig. 11), with β-sitosterol (483), daucosterol (484) and stigmasterol (485) as the main sterol constituents. Clistol G (476) and capsisteroids A-F (477–482) were obtained from the leaves of S. capsicoides [85], tumacones A (507) and B (508) and tumacosides A (509) and B (510) were from the leaves of S. nudum [242–247], carpesterol (517) was isolated from the seeds of S. capsicoides [86], and its derivatives (518–521) were reported from the fruits of S. xanthocarpum [401]. From the seeds of S. elaeagnifolium, 491, 495, 496 and 498 were yielded [134]. Additionally, two 26-aminocholestane-type glycosides, abutilosides A (528) and B (529), and five 26-hydroxycholestane-type glycosides, abutilosides C-G (534–538), were isolated from the fresh roots of S. abutiloides [5–9]. These compounds are important intermediates in the biogenesis of steroidal alkaloids [5].

Sterols in Solanum have indicated possession of anticancer [86], antifungal [401], and antiplasmodial [242, 245, 247] features. For instance, 509 and 510 displayed in vitro
antimalarial activity against \textit{P. falciparum} chloroquine-resistant FCB-1 strain (IC$_{50}$ = 27 and 16 μM) [247]. Compounds 511–515 from aerial parts of \textit{S. nudum} demonstrated antiplasmodial activity on hepatic trophozoites of \textit{P. vivax}. All the steroids reduced the number of hepatic \textit{P. vivax} trophozoites. Among them, 506 and 512 reduced the number
of hepatic trophozoites by 47 and 39 resp. [245]. Compound 517 produced antiproliferative activity in glioma (U251), breast (MCF-7), kidney (786-0), ovary (OVCAR-03), and K562 cell lineages [86]. In addition, 505-509 displayed antifungal activity by inhibiting radial growth of A. niger and T. viride [401].
Fig. 9 Lignans 414–444 from Solanum
3.12 Phenolic Compounds

Fifty-two phenolic compounds (542–593) were recorded from *Solanum* (Fig. 12). The fruits of *S. crinitum* have yielded 552, 561–564 [122]. Aerial parts of *S. torvum* indicated a great wealth of phenolic compounds, e.g. 558–559, 576, 591–593 [315, 320, 335–337, 521, 524, 533]. The highest numbers of phenols, 542–546, 549–540, 552, 555 and 589 were reported from stems of *S. melongena* [205] while 574–575 and 577–584 were mentioned from the fruits *S. sessiliflorum* [525].
Phenolic compounds in *Solanum* have displayed antibacterial [297, 320, 335–337, 524], anticancer [31], antidiabetic [297, 320, 335–337, 524] and antihypertensive [521] activities. Chlorogenic acid (546) (21.90 ± 0.02 mgg), gallic acid (551) (17.54 ± 0.04 mgg) and caffeic acid (555) (16.64 ± 0.01 mgg) have indicated potent and concentration-dependent DPPH radical-scavenging activity (IC$_{50}$ = 275.03 ± 7.8 μg/mL) [31], and 551 and 555
reportedly have great potentials as natural source of anti-diabetic and antioxidant drug [336]. \(\text{trans-Cinnamic acid (590)}\) showed antibacterial activities (MIC = 250 μg/mL) against \(\text{Staphylococcus aureus (297)}\), and antimycobacterial activities (inhibition zone = 0–22 mm) against \(\text{Proteus vulgaris, Klebsiella pneumoniae (ESBL-), M. tuberculosis (H}\text{\(^{37}\text{Rv})}\), and \(\text{M. tuberculosis (Rifampin)}\) [320]. Methyl caffeate (591) not only significantly reduced the cell proliferation, but also increased formation of fragmented DNA and apoptotic body in MCF-7 cells. In this study, Bcl-2, Bax, Bid, p53, caspase-3, PARP and cytochrome c release were detected by western blot analyses [474].
Fig. 12 Phenolic compounds 542–593 from Solanum
The effects of oral administration of 591 (10, 20 and 40 mg/kg) in streptozotocin induced diabetic rats, including body weight, fasting blood glucose, plasma insulin, hemoglobin, glycated hemoglobin, total protein, hepatic glycogen and carbohydrate metabolism enzymes have been studied for 28 days. At 40 mg/kg, the compound significantly prevented the increase in blood glucose level after glucose administration at 60 min in comparison to the hyperglycemic control group. It also produced remarkable reductions in blood glucose and increased body weight in streptozotocin induced diabetic rats [335]. Takahashi et al. further established that 591 has a most favorable structure for both sucrase and maltase inhibition against sucrose and that its moderate inhibitory action against alpha-glucosidase provides a prospect for antidiabetic usage of S. torvum fruit [337].

### 3.1.3 Coumarins and Coumestans

Seventeen coumarins 594–610 and three coumestans 611–613 were isolated from Solanum spp. (Fig. 13). The seeds of S. indicum yielded the highest number of...
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The coumarins 597–598 and 600–604 [535, 536], while coumestans 611–613 were from the whole plant of *S. lyratum* [88]. Scopolin (594), scopoletin (595) and coumarin (596) are the main coumarins in *Solanum*. Compounds 611–613 showed in vitro anti-inflammatory activities with IC\(_{50}\) values in the range of 6.3–9.1 μM [88].

### 3.14 Coumarinolignoids

Four coumarinolignoids known as indicumines A–D (614–617) were obtained from the seeds of *S. indicum* [535] (Fig. 14). Coumarinolignoids, including cleomiscosins, aquilochins and malloapelins, are unique and rare in nature. Coumarinolignoids of the cleomiscosins type bearing cleomiscosins A–D, 8-epi-cleomiscosin A, and malloapeli A functionalities have been identified in a few genera, including *Cleome viscosa*, *Mallotus apelta*, and *Rhododendron collettianum*. The compounds with such functionalities, especially cleomiscosins A–C and 8-epi-cleomiscosin A, which contributed to biological activities, have been reported with hepatoprotective and tyrosinase inhibition activities [535].

### 3.15 Fatty Acids and Esters

Nine saturated (618–619, 621, 627–628, 631, 634, 638–639) and 13 unsaturated (620, 622–626, 629, 630, 632, 633, 635–637, 640) fatty acids were reported from *Solanum* (Fig. 15). The whole plant of *S. glabratum* has yielded the highest number of fatty acid and esters (627–635) in *Solanum* spp. [140]. Hexadecanoic acid (618), notably the major fatty acid component in *Solanum*, was isolated from aerial parts of *S. aculeastrum* [11] *S. vestissimum* [489] and *S. villosum* [434, 479].

### 3.16 Others

Thirty other kinds of compounds (641–670) were also obtained from *Solanum* spp. (Fig. 16). Most of them, 642–653, were from the leaves of *S. aculeastrum* [11] and 654–659 were yielded from the fruits of *S. betaceum* [78]. An aldehyde pueraifuran (641) and a cyclic eight-membered α,β-unsaturated ketone, solalylarin B (661) were isolated from the whole plant of *S. lyratum* [88]. Compounds 641 and 661 showed in vitro anti-inflammatory activities, with IC\(_{50}\) values in the range 6.3–9.1 μM [88]. Also presented here are two furans, ethyl-α-D-arabinofuranoside...
(660) from the whole plant of *S. lyratum* and 5-hydroxymethyl furfural (663) from the stems of *S. torvum* [533]. Five aromatic glycosides (666–670) were also isolated from the aerial part of *S. incanum* [494] and the fruit of *S. lycopersicum* [511].

### 4 Conclusion and Future Prospects

From 1990 to 2017, phytochemical studies on the 65 *Solanum* species have yielded at least 670 compounds (134 steroidal saponins, 63 steroidal alkaloids, 13 pregnane glycosides, 128 terpenes, 75 flavonoids, 31 lignans, 31 alkaloids, 66 steroids, 52 phenolic compounds, 20 coumarins and coumestans, 4 coumarinolignoids, 23 fatty acids and esters, and 30 other types of compounds).

Pharmacological studies on *Solanum* genus have focused on antioxidants and anticancer activities. A total of 17 species (fruits of *S. aculeastrum*, *S. americanum*, *S. muricatum*, *S. sessiliflorum* and *S. spirale*, seeds of *S. capsicoides*, the stems of *S. cathayanum* and *S. tuberosum*, the roots of *S. diphyllum*, aerial parts of *S. surattense* and *S. torvum* and the whole plant parts of *S. aethiopicum*, *S. nigrum*, *S. anguivi*, *S. septemlobum*, *S. violaceum* and *S. xanthocarpum*) have been explored for anticancer activities and have exhibited significant results.

*S. xanthocarpum* has outstandingly demonstrated the most diverse pharmacological activities *e.g.* antioxidants and antitumor, anti-fungal, anti-bacterial, antileishmanial, mosquito larvicidal, molluscicidal, anti-diabetic, asthmatic, hepatoprotective, diuretic, nephrotoxicity, anti-inflammatory, anti-psoriatic, and anti-uricosuric.

Steroidal alkaloids have been presented as being largely responsible for various pharmacological activities of *Solanum* species, *e.g.* antibacterial (139, 141 and 145), anticonvulsant and CNS depressant (145), antidiabetic (139, 142 and 144), anti-fungal (145 and 174), anti-inflammatory (145), antileishmanial (139 and 142), molluscicidal (139...
and 141), nephrotoxicity (168), antioxidants and antitumor (139, 141, 145, 158, 168 and 180), antipROTOzoa (139 and 142), schistosomicidal (139 and 142), spasmolytic (190) and anti-trypanosomal (139).

The genus *Solanum* seems to possess great potential, yet majority of the species remain unknown or scantily studied for the chemical constituents. It would be very necessary for the phytochemistry researchers to explore and investigate more of its species. The vast pharmacological activities enanced by many compounds from *Solanum* genus should attract the attention of the pharmacological community to determine their exact target sites, structure–activity relationships and other medicinal applications.

**Compliance with Ethical Standards**

**Conflict of interest** The authors declare no conflict of interest.

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