











Review

Pentacyclic Triterpenoids Isolated from Celastraceae: A Focus in the ^{13}C -NMR Data

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Abstract: The Celastraceae family comprises about 96 genera and more than 1.350 species, occurring mainly in tropical and subtropical regions of the world. The species of this family stand out as important plant sources of triterpenes, both in terms of abundance and structural diversity. Triterpenoids found in Celastraceae species display mainly lupane, ursane, oleanane, and friedelane skeletons, exhibiting a wide range of biological activities such as antiviral, antimicrobial, analgesic, anti-inflammatory, and cytotoxic against various tumor cell lines. This review aimed to document all triterpenes isolated from different botanical parts of species of the Celastraceae family covering 2001 to 2021. Furthermore, a compilation of their ^{13}C -NMR data was carried out to help characterize compounds in future investigations. A total of 504 pentacyclic triterpenes were compiled and distinguished as 29 aromatic, 50 dimers, 103 friedelanes, 89 lupanes, 102 oleananes, 22 quinonemethides, 88 ursanes and 21 classified as others.

Keywords: Celastraceae; triterpenes; quinonemethide; ^{13}C -NMR



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1. Introduction

The Celastraceae family comprises approximately 96 genera, reaching about 1350 species distributed in the tropical and subtropical regions of the world [1,2]. Species of this family stand out for producing compounds with several pharmacological activities, such as antitumor [3,4], anti-inflammatory [5], antimicrobial [6–8], antioxidant [9] antiviral [10], analgesic [5,11], antiulcerogenic [12], hepatoprotective [13], hypoglycemic [13,14], immunomodulatory [15], among others. Considering the chemical composition, species of the Celastraceae family are rich in pentacyclic triterpenes (PCTTs). PCTTs show a range of biological properties, characterizing these plants as research targets aiming to obtain new bioactive compounds or prototypes of new drugs [16–22].

PCTTs are structurally diverse compounds and are therefore classified according to their main skeletal structure. The main classes found in Celastraceae family possess friedelane, oleanane, lupane, ursane and quinonemethide skeletons. Quinonemethides are chemomarkers of this family are found exclusively in these species [13]. These PCTTs can occur as alcohols, ketones, carboxylic acids, lactones, aldehydes, epoxides, esters, or even glycosylated derivatives. Furthermore, these PCTTs can be sub-classified as *seco*, generally due to the opening of one of their rings, the most common being the ring 'A' opening between carbons 3 and 4, and sub-classified as *nor* when there is a lack of any of the methyl groups that constitute the basic skeleton.

This review aims to present the PCTTs reported for species of the Celastraceae family in the 21st century, exhibiting from which species they were isolated and contributing to the chemical characterization process of these compounds listing their ^{13}C NMR data. The information about the PCTTs was obtained from SciFinder, Scopus, and Web of Science, using as key search terms: “Celastraceae and triterpenes”, “Celastraceae and compounds”, “Celastraceae and phytochemistry” and “Celastraceae and metabolites”. Articles with only ethnopharmacological information and data from *in vitro* and *in vivo* tests involving extracts or isolated substances were excluded. The period covering from January 2001 to September 2021 was considered since the group has already developed a free online database (in Portuguese) for the previous years [23]. This review reports a total of 504 pentacyclic triterpenoids, 29 aromatics (A), 50 dimers (D), 103 friedelanes (F), 89 lupanes (L), 102 oleananes (O), 22 quinonemethides (Q), 88 ursanes (U) and 21 classified as others. Table S1 (Supplementary Material) summarizes all these PCTTs, as well as the plant species and parts from which they were isolated.

2. Pentacyclic Triterpenoids (PCTTs)

PCTTs consist of 30 carbon atoms (six isoprene units) distributed over five fused rings (named A, B, C, D and E). This ring arrangement yields five six-membered rings or four six-membered rings fused to a 5-membered ring, numbered as shown in Figure 1 [24].

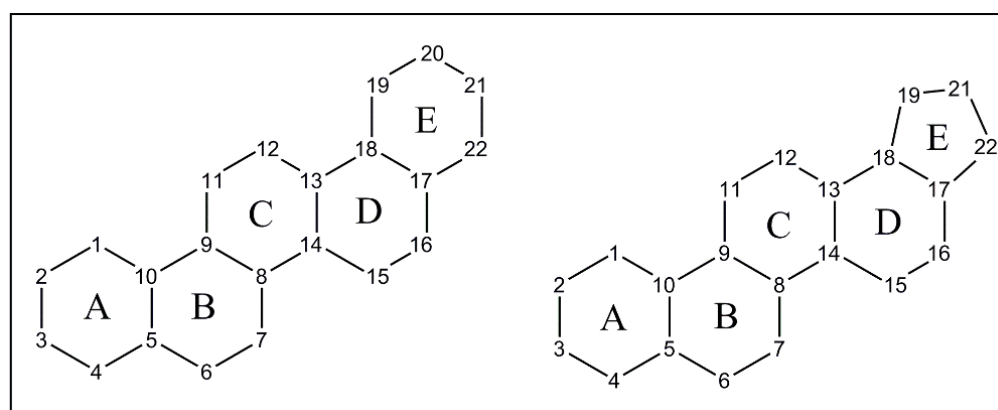


Figure 1. Core rings A, B, C, D, and E found in PCTTs.

As terpenes, the biosynthesis of PCTTs starts by the coupling of active isoprene units. Initially, there is an electrophilic condensation of IPP (isopentenyl diphosphate), with DMAPP (dimethylallyl diphosphate), yielding the precursor of monoterpenes, geranyl diphosphate (GPP). The addition of IPP to GPP generates farnesyl diphosphate (FPP), which is the precursor of sesquiterpenes. Then a tail-tail condensation of two FPP molecules leads to squalene, after the release of a diphosphate unit and a 1,3-alkyl shift (Figure 2) [25].

The biosynthesis of PCTTs continues with the oxidation of squalene, catalyzed by squalene epoxidase, forming 2,3-oxidosqualene. This intermediary assumes the “chair-chair-chair-boat” conformation and after a sequence of cyclizations yields the dammarenyl cation, which then undergoes a rearrangement forming the baccharenyl cation. From the baccharenyl cation, the key step in PCTTs biosynthesis occurs, characterized by the formation of the lupanyl cation (Figure 3) [25,26]. Through a sequence of carbocation rearrangements (1,2-shifts), involving hydride, methyl, and ring-opening shifts, the lupanyl cation yields the different PCTTs skeletons, which then could oxidize, reduce, and isomerize, leading to the formation of the different currently known PCTTs [25,26].

The most powerful spectroscopic method in the structural elucidation of PCTTs is ^{13}C Nuclear Magnetic Resonance (NMR). Comparison of experimental ^{13}C NMR chemical shifts with literature data is a useful tool in identifying the basic skeleton of these compounds. Through this data, it is possible to make predictions about the influence of a functional group on the chemical displacement of carbons from its basic skeleton [27]. According

to Mahato & Kundu [27], for example, the introduction of a hydroxyl group in the PCTT structure induces a deshielding of about 34–50 ppm of the α carbon, 2–10 ppm of the β carbons and 0–9 ppm of the γ carbons. The effect of the hydroxyl presence on the ^{13}C NMR chemical shift of the α -carbon, is related to its configuration, and with the number of γ -gauche-type, and 1,3-diaxial-type interactions with the carbon atoms of the triterpene skeleton [27].

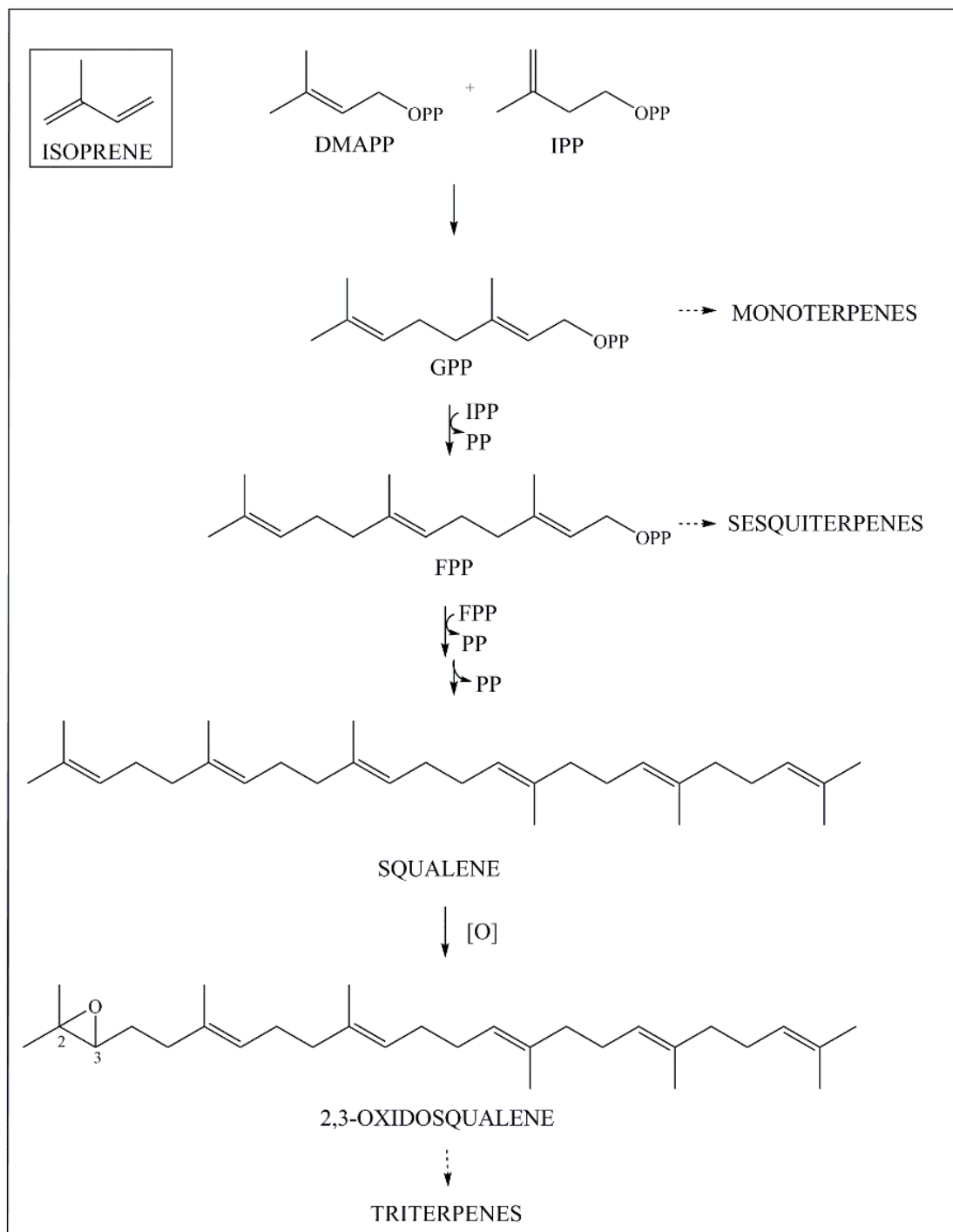


Figure 2. Simplified biosynthetic route of 2,3-oxidosqualene, the direct precursor of triterpenes, from isoprene. DMAPP: dimethylallyl diphosphate; IPP: isopentenyl diphosphate; GPP: geranyl diphosphate; FPP: farnesyl diphosphate; PP: diphosphate [26,28].

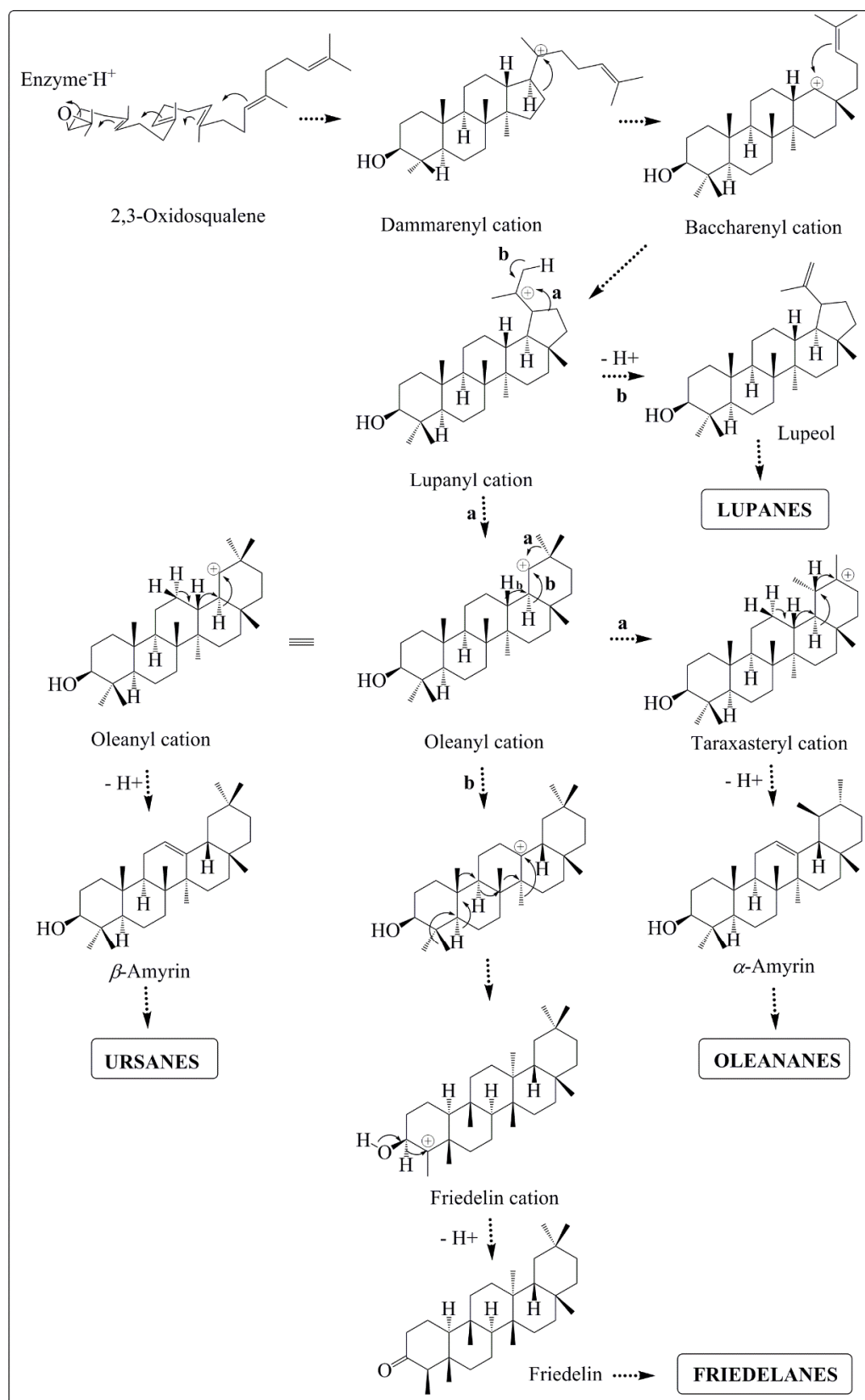
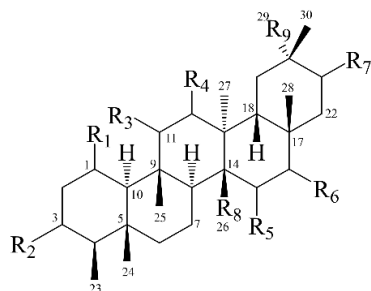


Figure 3. Simplified terpenoid biosynthetic route for the formation of the main pentacyclic triterpene skeletons isolated from Celastraceae species. “a” and “b” indicate two possible biosynthetic pathways [26,28].

2.1. Friedelanes

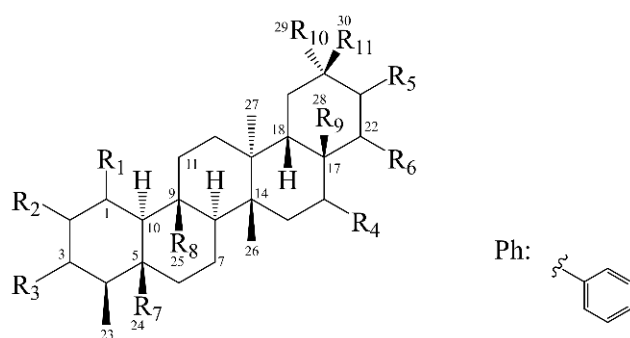
Compounds presenting a friedelane skeleton, together with the oleananes, are the most abundant PCTTs in the Celastraceae family, being found in the leaves, branches, roots and other parts of these plants [13]. These systems are formed by five six-membered rings fused. Rings A/B, B/C and C/D have *trans* configuration (H-10 α and H-8 α), while ring D/E is *cis* (H-18 β). They have eight methyl groups; six attached to distinct carbons, at positions 4 (Me 23 β), 5 (Me 24 β), 9 (Me 25 β), 13 (Me 27 α), 14 (Me 26 β) and 17 (Me 28 β), and two geminal methyl groups at carbon 20 (Me 29 α and 30 β) [22,29]. In this work, 103 PCTTs of friedelane skeleton (F) are reported, compounds F1–F103 (Figure 4).



	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈	R ₉
F1	H	=O	OH β	H	H	H	H	CH ₃	CH ₃
F2	H	=O	H	OH α	H	H	H	CH ₃	CH ₂ OH
F3	H	=O	H	OH α	H	=O	H	CH ₃	CH ₃
F4	H	=O	H	OH α	H	H	H	CH ₃	CH ₃
F5	H	=O	H	OH β	H	H	H	CH ₃	CH ₃
F6	H	=O	H	H	OH α	H	H	CH ₂ OH	CH ₃
F7	H	=O	H	H	OH α	H	H	CH ₃	CH ₃
F8	=O	=O	H	H	H	OCOCH ₃	H	CH ₂ OH	CH ₃
F10	=O	=O	H	H	H	OH α	H	CH ₃	CH ₃
F11	H	=O	H	H	H	OH α	H	CH ₃	CH ₃
F13	H	=O	H	H	H	OH β	H	CH ₃	CH ₂ OH
F14	H	=O	H	H	H	OH β	H	CH ₃	CH ₃
F15	OH α	=O	H	H	H	H	H	CH ₃	CH ₂ OH
F18	OH β	=O	H	H	H	H	H	CH ₃	CH ₃
F19	=O	=O	H	H	H	H	OH α	CH ₃	CH ₃
F20	H	=O	H	H	H	H	OH α	CH ₃	CH ₃
F21	H	=O	H	H	=O	H	OH α	CH ₃	CH ₃
F22	H	=O	H	H	H	H	OH β	CH ₃	CH ₃
F26	=O	=O	H	H	H	H	H	CH ₂ OH	CH ₃
F33	=O	=O	H	H	H	H	H	CH ₃	CH ₂ OH
F34	H	=O	H	H	H	=O	H	CH ₃	CH ₂ OH
F35	H	=O	H	H	H	H	H	CH ₃	CH ₂ OH
F46	=O	H	H	H	H	H	H	CH ₃	CHO
F49	H	=O	H	H	H	H	H	CH ₃	COOCH ₃
F54	=O	OH β	H	H	H	H	H	CH ₃	CH ₂ OH
F73	H	=O	H	H	H	H	H	CH ₃	COOH
F80	H	OH β	H	H	H	H	H	CH ₃	CH ₂ OH
F82	=O	=O	H	H	H	H	=O	CH ₃	CH ₃
F83	=O	=O	H	H	H	H	H	CH ₃	CH ₃
F84	H	=O	=O	H	H	H	H	CH ₃	CH ₃
F85	H	=O	H	=O	H	H	H	CH ₃	CH ₃
F86	H	=O	H	H	=O	H	H	CH ₃	CH ₃
F87	H	=O	H	H	H	=O	H	CH ₃	CH ₃
F89	H	=O	H	H	H	H	H	CH ₃	CH ₃
F90	H	OH β	OH β	H	H	H	H	CH ₃	CH ₃
F93	H	OH β	H	H	H	H	H	CH ₃	CH ₃
F94	H	=O	H	H	H	H	=O	CH ₃	CH ₃

(a)

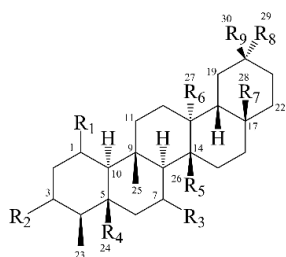
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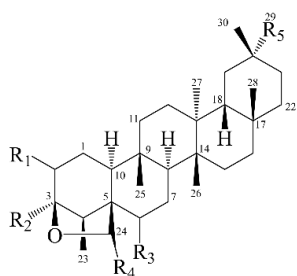
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F9	H	H	=O	OH α	H	H	CH ₃	CH ₃	CH ₂ OH	CH ₃	CH ₃
F12	H	H	=O	OH β	H	H	CH ₃	CH ₃	CH ₂ OH	CH ₂ OH	CH ₃
F16	OH β	H	=O	H	H	H	CH ₃	CH ₂ OH	CH ₃	CH ₃	CH ₃
F17	OH β	H	=O	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	CH ₂ OH
F24	H	H	=O	H	H	H	CH ₃	CH ₂ OH	CH ₃	CH ₃	CH ₃
F25	H	H	=O	H	=O	H	CH ₃	CH ₂ OH	CH ₃	CH ₃	CH ₃
F28	H	H	=O	H	H	H	CH ₃	CH ₃	CH ₂ OH	CH ₂ OH	CH ₃
F29	H	H	=O	H	H	H	CH ₃	CH ₃	CH ₂ OH	CH ₃	CH ₂ OH
F30	=O	H	=O	H	H	H	CH ₃	CH ₃	CH ₂ OH	CH ₃	CH ₃
F31	H	H	=O	H	H	H	CH ₃	CH ₃	CH ₂ OH	CH ₃	CH ₃
F32	H	H	=O	H	H	H	CH ₃	CH ₃	CHO	CH ₂ OH	CH ₃
F37	H	OH α	=O	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	CH ₃
F40	H	H	=O	H	=O	H	CH ₃	OCOPh	CH ₃	CH ₃	CH ₃
F41	=O	H	=O	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	CH ₂ OH
F42	H	H	=O	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	CH ₂ OH
F47	H	H	=O	H	H	H	CH ₃	CH ₃	CHO	CH ₃	CH ₃
F48	H	H	=O	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	CHO
F50	H	=O	OH α	H	H	H	CH ₃	CH ₂ OH	CH ₃	CH ₃	CH ₃
F51	H	=O	OH α	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	CH ₃
F63	OH β	H	=O	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	COOH
F65	H	OH α	OH α	H	=O	OH β	COOH	CH ₃	CH ₃	H	CH ₃
F66	H	OH α	=O	H	H	H	CH ₃	CH ₃	CH ₃	COOH	CH ₃
F67	H	OH α	=O	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	COOH
F68	H	OH β	=O	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	COOH
F71	H	H	=O	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	COOH
F72	H	H	=O	H	H	H	CH ₃	CH ₃	COOH	CH ₃	CH ₃
F74	H	=O	OH α	H	H	H	CH ₃	CH ₃	CH ₃	COOH	CH ₃
F76	H	H	OH α	H	H	H	CH ₃	CH ₃	CH ₃	COOH	CH ₃
F78	H	=O	OH β	H	H	H	CH ₃	CH ₃	CH ₃	COOH	CH ₃
F92	H	H	OH β	H	H	H	CH ₃	CH ₃	CH ₂ OH	CH ₂ OH	CH ₃

(b)

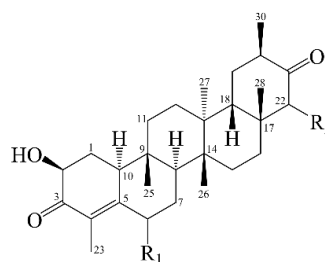
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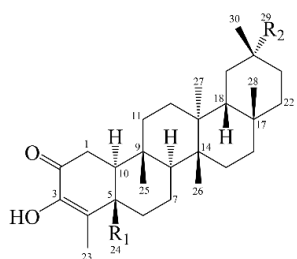
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F58	=O	=O	OH α	CH ₃	CH ₃	CH ₃	CH ₃	CH ₃	CH ₃
F59	H	=O	OH α	CH ₃	CH ₂ OH	CH ₃	CH ₃	CH ₃	CH ₃
F60	H	=O	OH α	CH ₃	CH ₃	CH ₃	CH ₃	CH ₃	CH ₂ OH
F61	H	=O	OH β	CH ₃	CH ₃	CH ₃	CH ₃	CH ₂ OH	CH ₃
F62	H	=O	OH β	CH ₃	CH ₃	CH ₃	COOCH ₃	CH ₃	CH ₃
F79	H	=O	OH β	CH ₃	CH ₃	CH ₃	COOH	CH ₃	CH ₃
F88	H	=O	=O	CH ₃	CH ₃	CH ₃	CH ₃	CH ₃	CH ₃
F91	H	OH β	H	CH ₂ OH	CH ₃	CH ₃	CH ₃	CH ₃	CH ₃



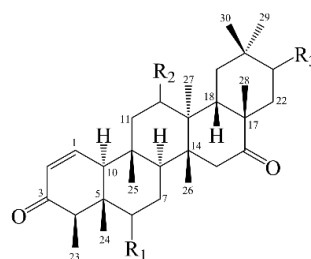
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F52	OH α	OH	OH β	H	COOCH ₃
F53	OH α	OH	H	H	COOCH ₃
F64	OH α	OH	H	H	COOH
F75	H	OH	H	H	COOH
F77	OH α	H	H	OH	COOH



	R ₁	R ₂
F39	H	H
F56	OH α	OH β
F99	H	OH β



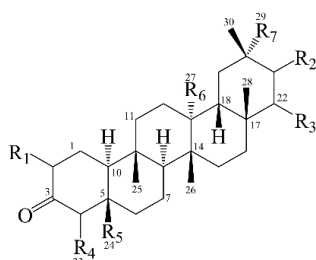
	R ₁	R ₂
F43	CHO	COOCH ₃
F69	CHO	COOH
F70	CH ₃	COOH



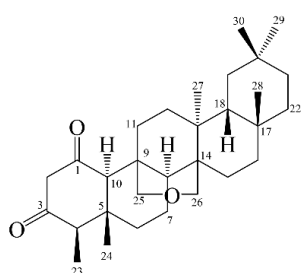
	R ₁	R ₂	R ₃
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F81	H	H	H

(c)

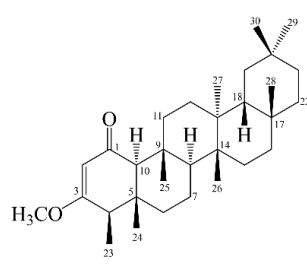
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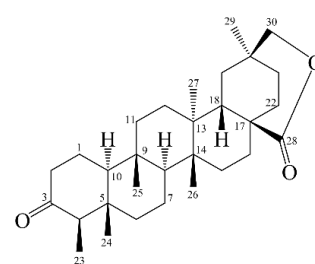
	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇
F38	OH β	=O	OH β	CH ₃ β	COOCH ₃	CH ₃	H
F55	H	H	H	CH ₃ α	CH ₃	CH ₃	CH ₃
F98	H	H	H	CH ₃ β	CH ₃	CH ₃	CH ₂ OCHO



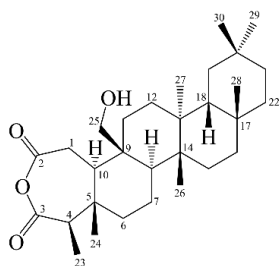
F23



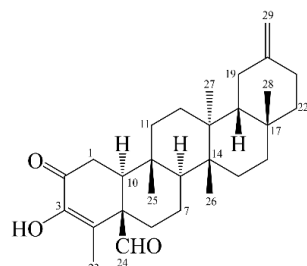
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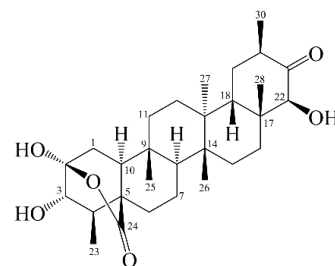
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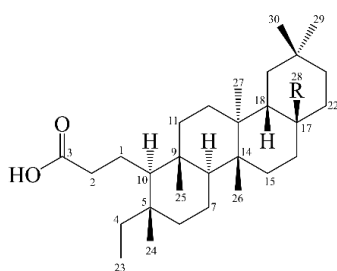
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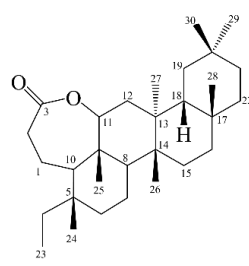
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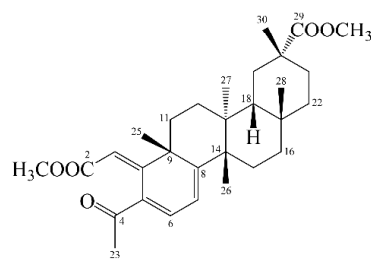
F97



F100



F101



F103

	R
F101	CH ₂ OH
F102	CH ₃

(d)

Figure 4. Structures of friedelane-type pentacyclic isolated from Celastraceae species (2001–2021). (a) Compounds F1–F8, F10, F11, F13–F15, F18–F22, F26, F33–F35, F46, F49, F54, F73, F80, F82–F87, F89, F90, F93 and F94. (b) Compounds F9, F12, F16, F17, F24, F25, F28–F32, F37, F40–F42, F47, F48, F50, F51, F63, F65–F68, F71, F72, F74, F76, F78 and F92. (c) Compounds F27, F36, F39, F43, F52, F53, F56, F57, F58–F62, F64, F69, F70, F75, F77, F79, F81, F88, F91 and F99. (d) Compounds F23, F38, F44, F45, F55, F95–F98, F100–F103.

An important observation in the ^{13}C NMR data of 3-oxo friedelanes is the shielding of methyl group 23, which has a chemical shift value around δ_{C} 7.0 ppm. This occurs since this methyl is found in a cone region, generated by the π electrons of the carbonyl group at C-3, which promotes a region of shielding magnetic anisotropy [30].

2.2. Quinonemethides and Aromatics

Quinonemethides are compounds isolated exclusively in species of the Celastraceae family, and can also be found in the form of dimers or trimers [31]. Hypotheses about their origin assume that they are formed from friedelane derivatives, which are transported from the leaves to the roots, where they are converted into quinonemethides [32]. They are characterized as 24-*nor*-triterpenoids, due to the absence of methyl 24, and also they have functional oxygenated groups attached to carbons 2 and 3 [33]. Aromatic skeleton PCTTs are a subgroup of quinonemethides, which are characterized by the aromaticity of the A ring. Between 2001 and 2021 about 22 quinonemethides (Q), Q1–Q22 (Figure 5), and 29 aromatics analogues (A), A1–A29 (Figure 6) were isolated from Celastraceae species.

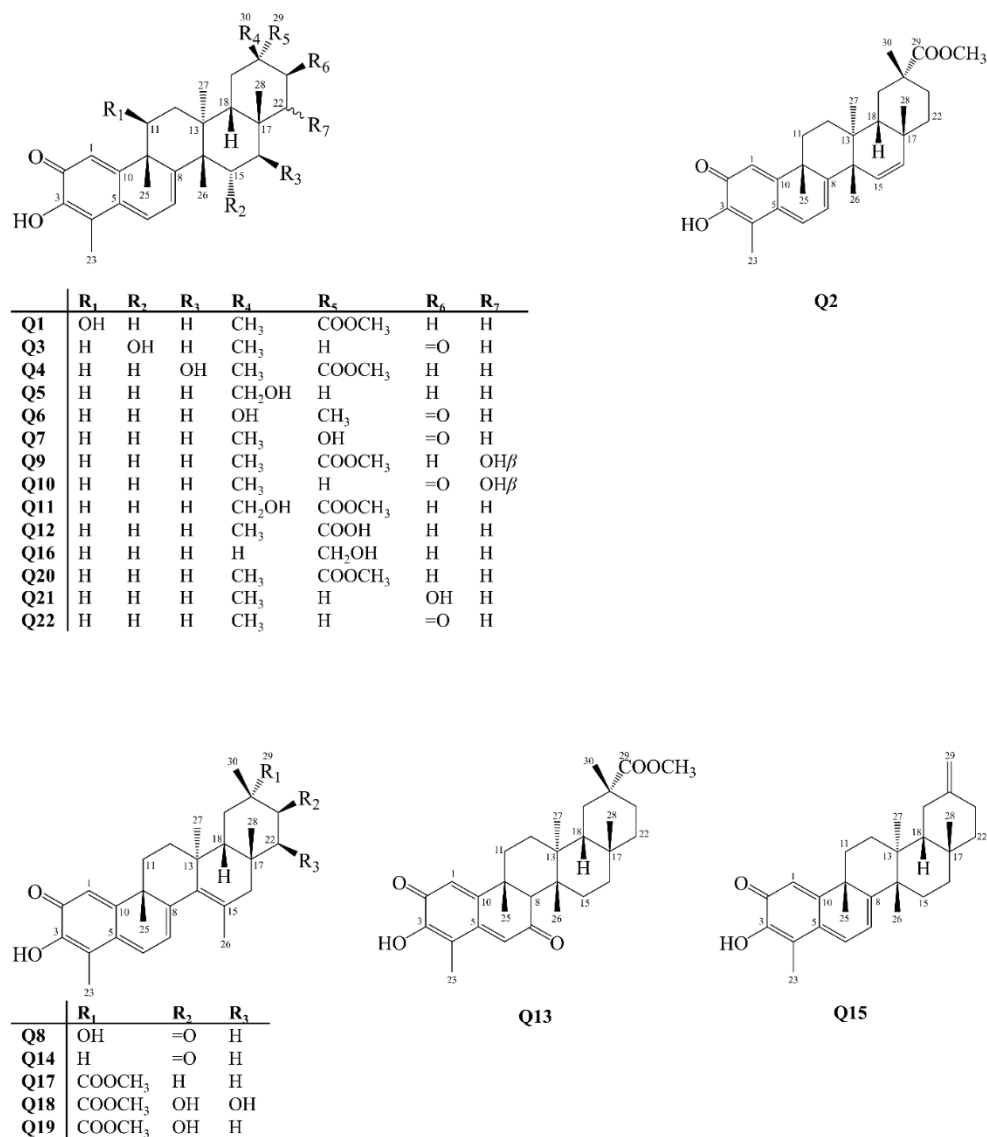
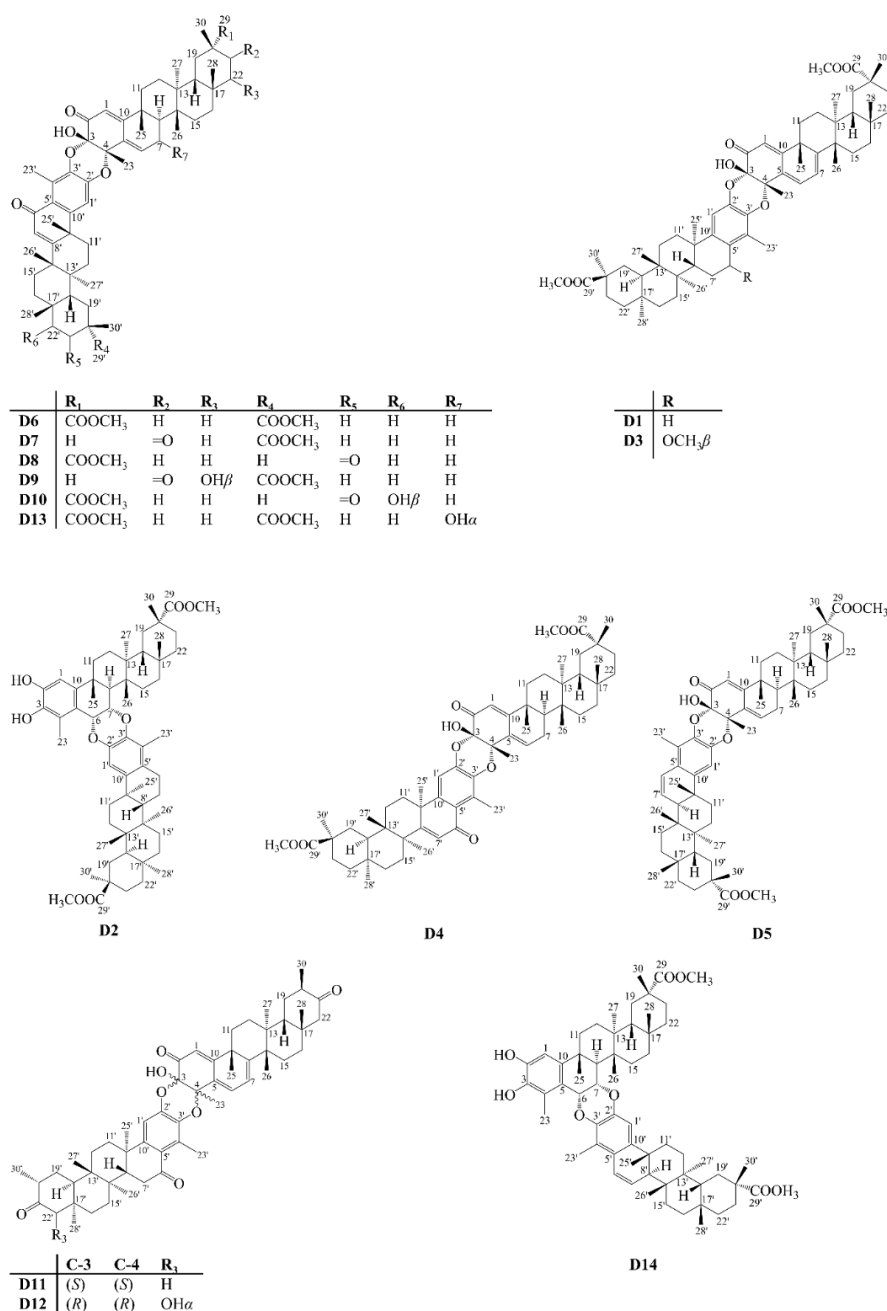


Figure 5. Structures of quinonemethide-type pentacyclic triterpenoids isolated from Celastraceae species (2001–2021).

2.3. Dimers

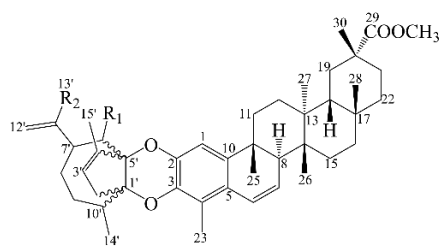
Dimers are formed from PCTTs of the quinonemethide class and its aromatic derivatives, therefore they are also restricted to the Celastraceae family. According to Bazzocchi, Núñez and Reyes [31], these triterpenes are possibly biosynthesized through a Diels-Alder reaction, in which the different possible orientations of the monomers during the reaction result in a variety of isomers.

Between the years 2001 and 2021, 50 dimers (**D**), **D1–D50**, were reported (Figure 7). Most of these dimers are formed by two triterpenes with quinonemethide skeleton or their aromatic derivatives. However, the formation of adducts can also occur from the combination of a triterpene and a sesquiterpene (**D15–D24**; **D37–D38**).

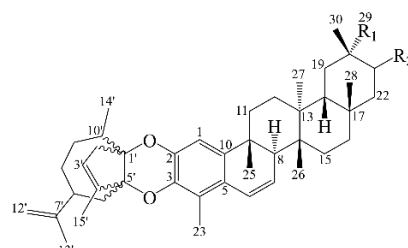


(a)

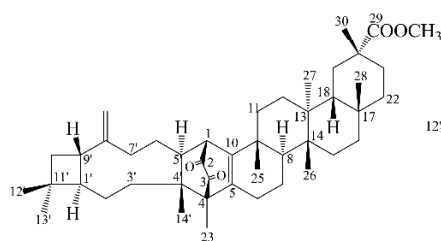
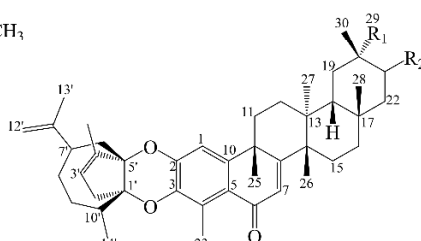
Figure 7. Cont.



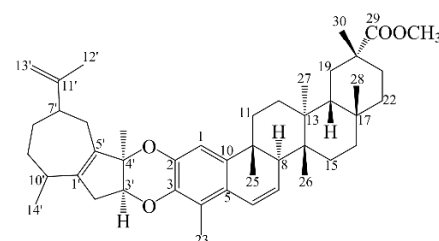
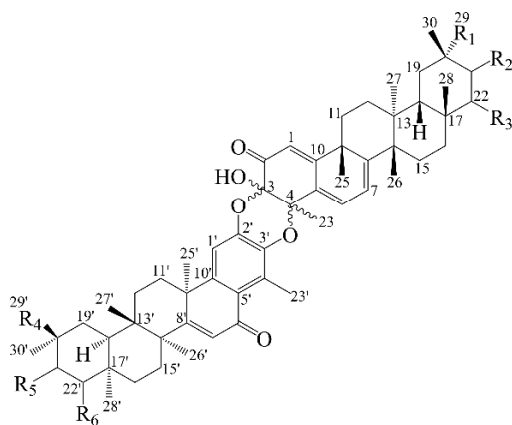
	C-1'	C-5'	R ₁	R ₂
D16	(S)	(S)	H	CH ₃
D18	(R)	(R)	H	CH ₃
D20	(R)	(R)	OH	COOH



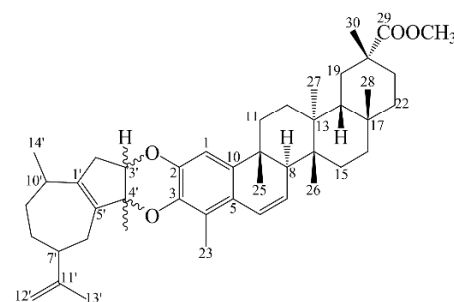
	C-1'	C-5'	R ₁	R ₂
D17	(R)	(R)	COOCH ₃	H
D19	(S)	(S)	COOCH ₃	H
D37	(S)	(S)	H	=O

**D15**

	R ₁	R ₂
D21	COOCH ₃	H
D38	H	=O

**D22**

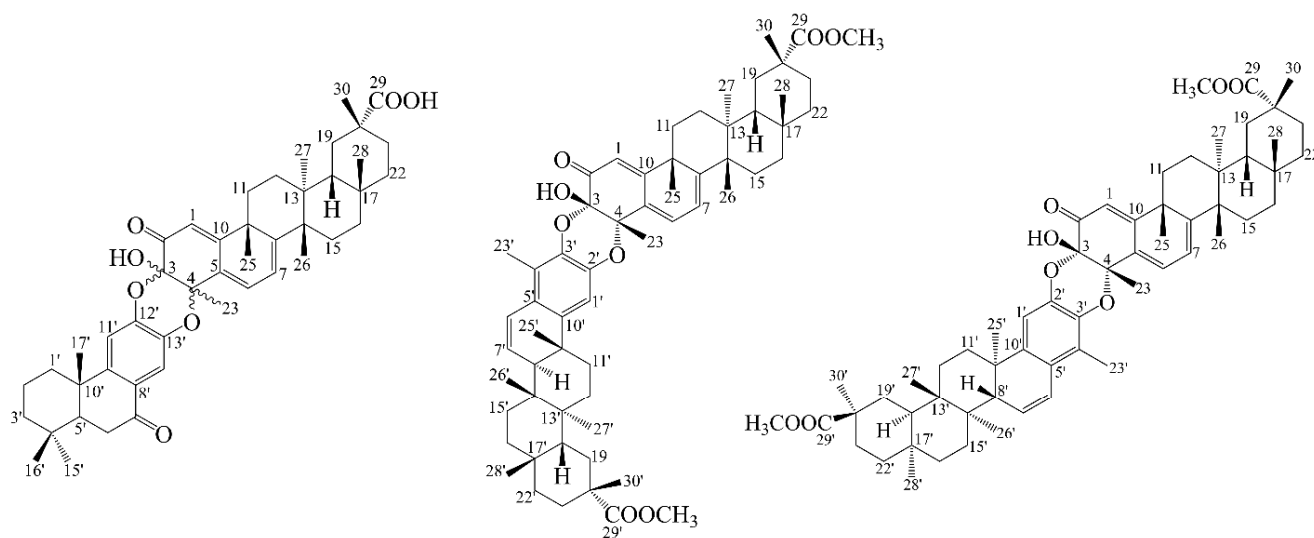
	C-3	C-4	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆
D25	(R)	(R)	COOH	H	H	COOH	H	H
D26	(S)	(S)	COOH	H	H	COOH	H	H
D40	(R)	(R)	COOCH ₃	H	H	COOCH ₃	H	H
D41	(S)	(S)	H	=O	H	COOCH ₃	H	H
D42	(S)	(S)	H	=O	OH β	COOCH ₃	H	H
D43	(R)	(R)	H	=O	OH β	COOCH ₃	H	H
D44	(S)	(S)	COOCH ₃	H	H	H	=O	OH α
D45	(R)	(R)	COOCH ₃	H	H	H	=O	OH α
D46	(S)	(S)	H	=O	H	COOCH ₃	=O	H
D47	(S)	(S)	COOCH ₃	=O	H	H	=O	H



	C-3'	C-4'
D23	(R)	(S)
D24	(S)	(R)

(b)

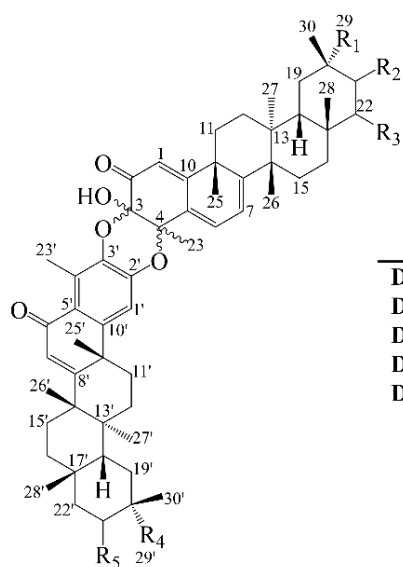
Figure 7. Cont.



	C-3	C-4
D27	(R)	(R)
D28	(S)	(S)

D29

D30



	C-3	C-4	R ₁	R ₂	R ₃	R ₄	R ₅
D32	(S)	(S)	COOH	H	H	COOH	H
D33	(R)	(R)	COOCH ₃	H	H	COOCH ₃	H
D34	(S)	(S)	H	=O	H	COOCH ₃	H
D35	(R)	(R)	COOCH ₃	H	H	H	=O
D36	(S)	(S)	H	=O	OH _β	COOCH ₃	H

(c)

Figure 7. Cont.

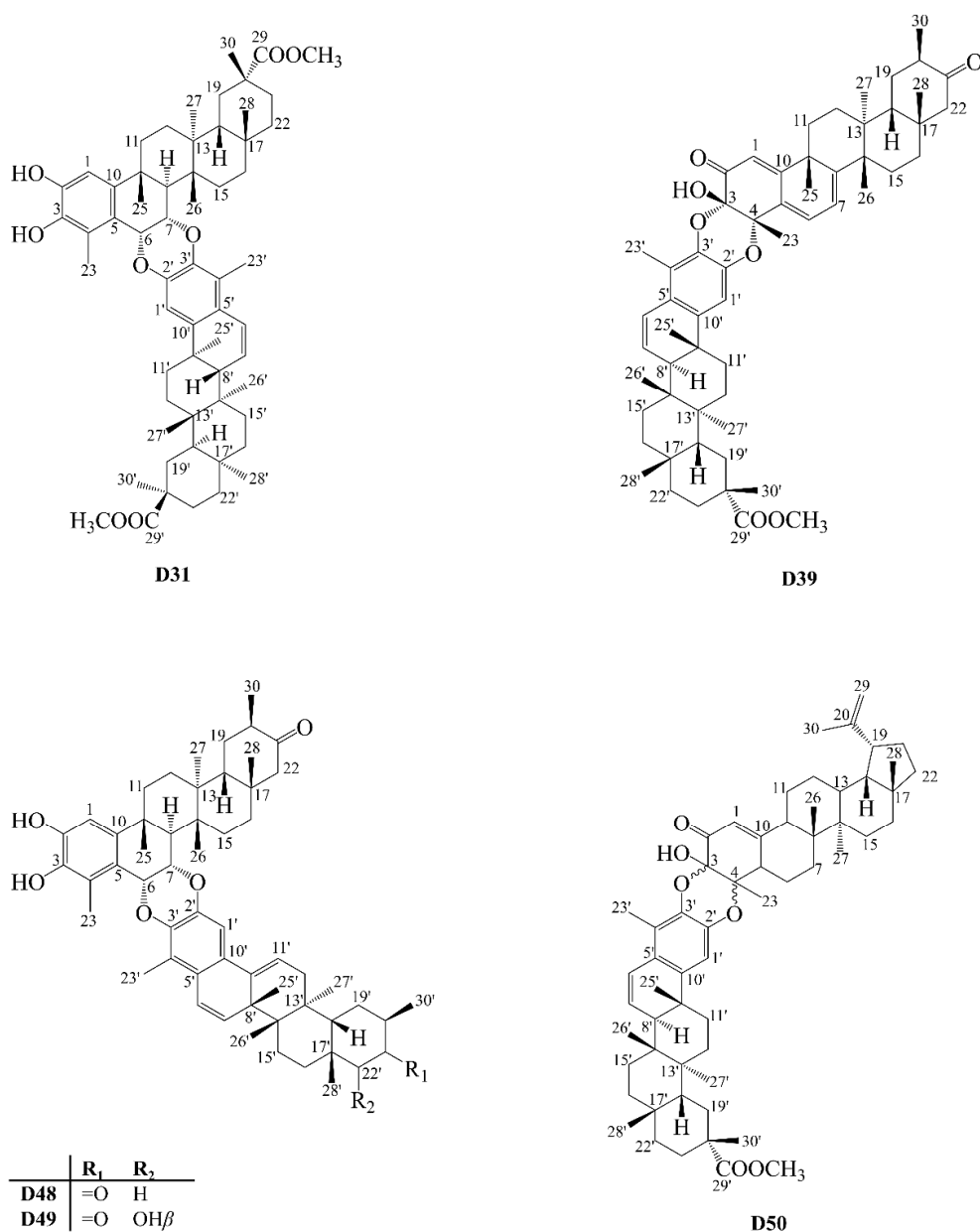
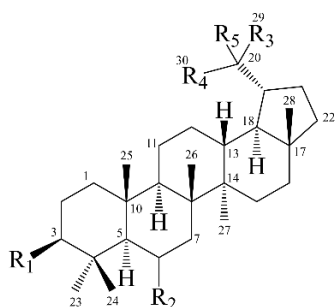


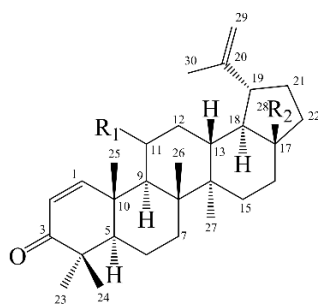
Figure 7. Structures of dimer-type pentacyclic triterpenoids isolated from Celastraceae species (2001–2021). (a) Compounds D1–D14. (b) Compounds D15–D26, D37, D38 and D40–D47. (c) Compounds D27–D30 and D32–D36. (d) Compounds D31, D39 and D48–D50.

2.4. Lupanes

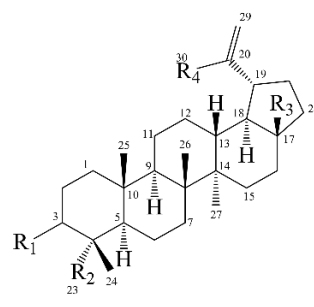
Unlike other skeletons, lupane-type PCTTs are formed by a *trans* pentacyclic ring system, in which the E ring is five-membered with an isopropenyl α substituent at carbon 19, containing a double bond between carbons 20 and 29 [19,22]. They have seven methyl groups, with two geminal ones attached to carbon 4 (Me 23 α and 24 β) and the others attached to carbon 8 (Me 26 β), 10 (Me 25 β), 14 (Me 27 α), 17 (Me 28 β), and 20 (Me 30), respectively. In this review, 89 pentacyclic triterpenoids of the lupane-type (L), L1–L89, were reported (Figure 8).



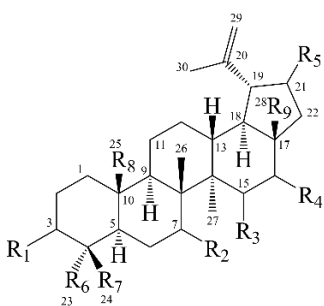
	R ₁	R ₂	R ₃	R ₄	R ₅
L1	OH β	H	CHO	CH ₃	H
L2	OH β	H	CH ₃	CHO	H
L44	=O	OH β	CH ₃	CH ₃	OH
L76	OH β	H	CH ₃	CH ₃	OH
L84	OH β	OH β	CH ₃	CH ₃	OH



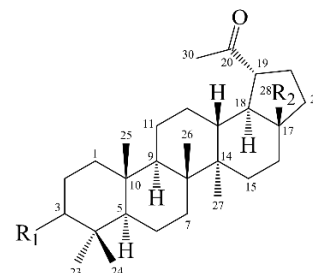
	R ₁	R ₂
L4	OH α	CH ₃
L13	H	CH ₂ OH
L19	H	CHO
L61	H	CH ₃



	R ₁	R ₂	R ₃	R ₄
L7	=O	CH ₃	OH	CH ₃
L83	OH β	CH ₂ OH	CH ₃	CH ₂ OH

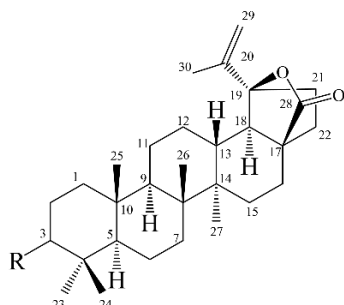


Senecieryl:

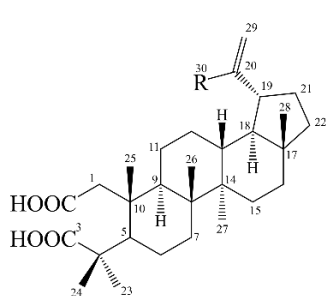


	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈	R ₉
L6	=O	H	H	OH β	H	CH ₃	CH ₃	CH ₃	CH ₃
L9	=O	H	H	H	OH β	CH ₃	CH ₃	CH ₃	CH ₃
L10	=O	H	H	H	H	CH ₃	CH ₂ OH	CH ₃	CH ₂ OH
L33	OH β	OH β	H	H	H	CH ₃	CH ₃	CH ₃	COOCH ₃
L51	=O	H	H	H	H	CH ₂ OH	CH ₃	CH ₃	COOH
L56	OH α	OSeneciyl β	H	H	H	CH ₃	CH ₃	CH ₃	COOH
L67	=O	H	H	H	=O	CH ₃	CH ₃	CH ₃	CH ₃
L74	OH β	H	OH α	H	H	CH ₃	CH ₃	CH ₃	CH ₃
L75	OH β	H	H	OH β	H	CH ₃	CH ₃	CH ₃	CH ₃
L77	OH β	H	H	H	H	CH ₃	CH ₃	CH ₂ OH	CH ₃

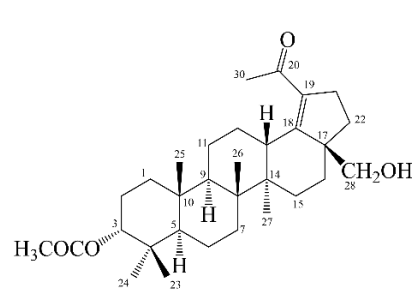
	R ₁	R ₂
L15	=O	CH ₃
L28	OH β	OH β
L30	OH β	CH ₂ OH
L39	OH β	CHO
L40	OH β	CH ₃



	R
L17	OH α
L87	OH β
L88	=O



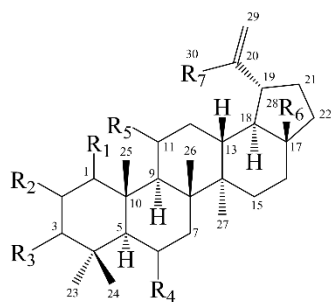
	R
L49	CH ₃
L50	CH ₂ OH



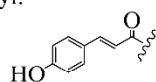
L22

(a)

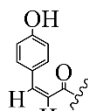
Figure 8. Cont.



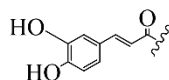
(E)Coumaroyl:



(Z)Coumaroyl:



Caffeoyl:



	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇
L3	H	H	=O	H	OH α	OH	CH ₃
L5	H	H	=O	H	OH α	CH ₃	CH ₃
L8	OH α	H	=O	H	H	CH ₃	CH ₃
L11	H	H	=O	H	H	CH ₂ OH	CH ₂ OH
L12	H	H	=O	H	H	CH ₂ OH	CHO
L14	H	H	=O	H	H	CH ₂ OH	CH ₃
L16	H	H	=O	H	H	CH ₃	CH ₂ OH
L18	H	H	=O	H	OH α	CHO	CH ₃
L20	H	H	=O	H	H	CH ₃	CHO
L21	H	=O	OH α	H	H	CH ₂ OH	CH ₃
L23	H	H	OCOCH ₃ α	H	H	CH ₃	CHO
L24	H	H	OH α	H	H	CHO	CH ₃
L25	H	=O	OH α	H	H	CH ₃	CH ₃
L26	H	H	(E) OCoumaroyl	H	H	CH ₂ OH	CH ₃
L27	H	H	(Z) OCoumaroyl	H	H	CH ₂ OH	CH ₃
L31	H	=O	OH β	H	H	CH ₂ OH	CH ₃
L32	H	H	OH β	H	H	CHO	CH ₂ OH
L34	OH β	H	OCOCH ₃ β	H	H	CH ₃	CH ₃
L35	H	H	OCaffeoyl β	H	H	CH ₂ OH	CH ₃
L36	OH β	H	OCaffeoyl β	H	H	CH ₃	CH ₃
L37	H	H	OCaffeoyl β	H	H	CH ₃	CH ₃
L38	H	H	OCO(CH ₂) ₁₆ CH ₃ β	H	H	CH ₃	CH ₃
L41	H	=O	OH β	H	H	CH ₃	CH ₃
L42	H	H	OH β	H	H	CHO	CH ₃
L43	H	H	OH β	H	H	CH ₃	CHO
L45	H	H	=O	OH β	H	CH ₂ OH	CH ₃
L46	H	H	=O	OH β	H	CH ₃	CH ₂ OH
L47	H	H	=O	OH β	H	CH ₃	CHO
L48	H	H	OCOCH ₃ β	H	H	CH ₃	CH ₃
L52	H	H	=O	OH β	H	COOH	CH ₃
L53	H	H	=O	H	H	COOH	CH ₃
L54	H	H	=O	H	H	CH ₃	COOH
L57	H	H	OH α	H	H	CH ₃	COOH
L58	H	H	OH α	H	H	COOH	CH ₃
L59	H	H	OH β	H	H	COOH	CH ₃
L60	H	H	OCH ₃ β	H	H	COOH	CH ₃
L62	H	H	OH β	H	H	CH ₃	CH ₂ OH
L63	OH β	H	OH α	H	H	CH ₂ OH	CH ₃
L64	OH β	H	OH α	H	H	CH ₃	CH ₃
L65	OH β	H	OH β	H	H	CH ₃	CH ₃
L66	H	OH β	OH β	H	H	CH ₃	CH ₃
L68	H	H	=O	H	H	CH ₃	CH ₃
L69	H	H	OH α	H	OH α	CH ₂ OH	CH ₃
L70	H	H	OH α	H	OH α	CH ₃	CH ₃
L71	H	H	OH α	H	H	CH ₂ OH	CH ₃
L72	H	H	OH α	H	H	CH ₃	CH ₃
L73	H	H	OH β	H	OH α	CH ₃	CH ₃
L78	H	H	OH β	H	H	CH ₂ OH	CH ₂ OH
L79	H	H	OH β	H	H	CH ₂ OH	CH ₃
L80	H	H	OH β	H	H	CH ₃	CH ₂ OH
L81	H	H	OH β	OH β	H	CH ₃	CH ₃
L82	H	H	OH β	H	H	CH ₃	CH ₃
L85	H	H	OH β	OH β	H	CH ₂ OH	CH ₃

(b)

Figure 8. Cont.

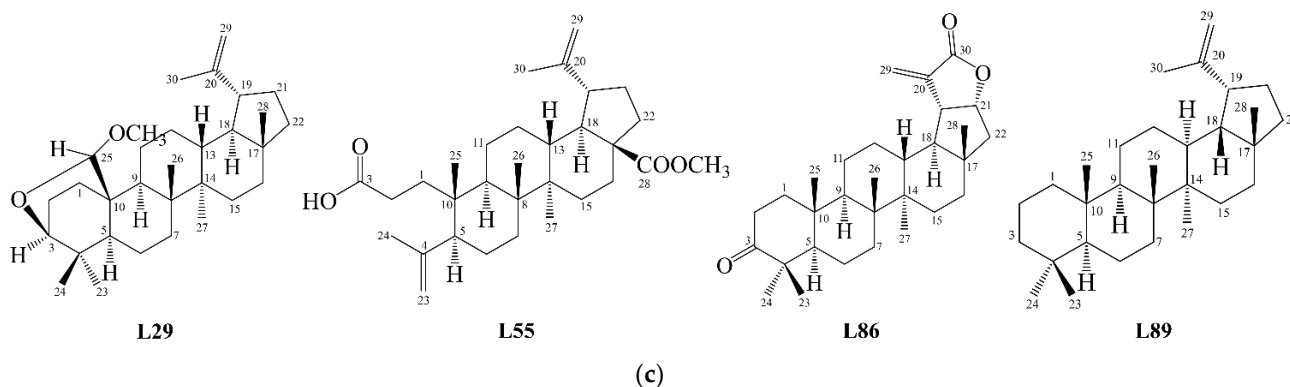


Figure 8. Structures of lupane-type pentacyclic triterpenoids isolated from Celastraceae species (2001–2021). (a) Compounds L1, L2, L4, L6, L7, L9, L10, L13, L15, L17, L19, L22, L28, L30, L33, L39, L40, L44, L49–L51, L56, L61, L67, L74–L77, L83, L84, L87 and L88. (b) Compounds L3, L5, L8, L11, L12, L14, L16, L18, L20, L21, L23–27, L31, L32, L34–L38, L41–L43, L45–L48, L52–L54, L57–L60, L62–L66, L68–L73, L78–L82 and L85. (c) Compounds L29, L55, L86 and L89.

Characteristic ^{13}C -NMR signals of the class of lupanes are those in the olefinic region, which appear around δ_{C} 109 (C-29) and δ_{C} 150 ppm (C-20), and signals from the methine carbons C-5 ($\text{H}\alpha$), C-9 ($\text{H}\alpha$), C-13 ($\text{H}\beta$), C-18 ($\text{H}\alpha$), and C-19 ($\text{H}\beta$), observed around δ_{C} 55, 50, 38, 48 and 47 ppm, respectively.

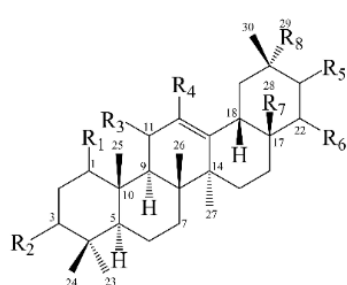
2.5. Oleananes

Oleanane-type triterpenoids are characterized by the presence of a double bond, most commonly between carbons 12 and 13. Rings A/B, B/C, and C/D have *trans* configuration, whereas rings D/E are *cis*. They have eight methyl groups. Geminal ones 23 (α) and 24 (β) are connected to carbon 4, and 29 (α) and 30 (β) to carbon 20. The others are connected to carbons 8 (Me 26 β), 10 (Me 25 β), 14 (Me 27 α) and 17 (Me 28 β) [19]. In this work, 102 pentacyclic triterpenoids with oleanane skeleton (O), O1–O102, were reported (Figure 9).

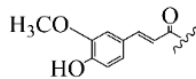
In the ^{13}C -NMR spectrum, the signals that characterize oleananes are those related to the double bond carbon atoms. For the most common oleananes with double bond between carbons 12 and 13, the chemical shifts are observed around δ_{C} 122 (C-12) and δ_{C} 145 ppm (C-13), except for those that have substituents close to these carbons [27].

2.6. Ursanes

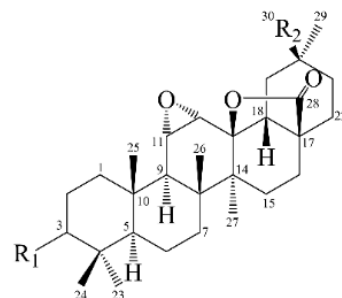
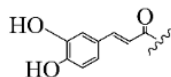
Ursanes differ structurally from oleananes only by the position of methyl group 29, which is attached to carbon 19, in a β position. In the structure of ursanes, methyl group 30 is found in α position. Rings A/B, B/C and C/D have *trans* configuration, while rings D/E have *cis* configuration, like oleananes. The most common ursanes also present a double bond between carbons 12 and 13 [19]. There were 88 ursanes (U) isolated from Celastraceae species, triterpenoids U1 to U88, were reported (Figure 10).



Feruloyl:

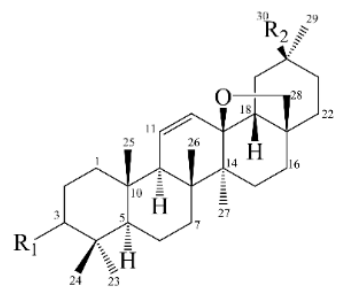


Caffeoyl:

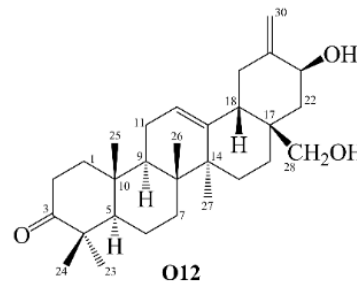


	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈
O3	H	=O	OH α	H	H	H	CH ₃	CH ₃
O4	H	=O	OCH ₃ α	H	H	H	CH ₃	CH ₃
O5	H	OH α	OCH ₃ α	H	OH β	H	CH ₃	CH ₃
O6	H	OH β	OCH ₃ α	H	H	H	CH ₃	CH ₃
O7	H	=O	OH β	H	OH β	H	CH ₃	CH ₃
O8	H	=O	OH β	H	H	H	CH ₃	CH ₃
O10	OH α	OH β	=O	H	H	H	H	CH ₃
O13	H	=O	H	H	OH β	H	CH ₃	CH ₃
O14	H	=O	=O	H	H	H	CH ₂ OH	CH ₃
O15	H	OCO(CH ₂) ₁₂ CH ₃ β	H	H	H	OH α	CH ₃	COOCH ₃
O25	H	OH α	=O	H	H	H	CH ₂ OH	CH ₃
O26	H	OCOCH ₃ α	=O	H	H	H	CH ₂ OH	CH ₃
O27	H	OH β	=O	OH	H	H	CH ₃	CH ₃
O30	H	OCaffeoyl β	H	H	H	H	CH ₃	CH ₃
O33	H	OCO(CH ₂) ₁₆ CH ₃ β	H	H	H	H	CH ₃	CH ₃
O36	H	OH β	=O	H	H	H	CH ₃	CH ₃
O38	H	OH β	H	H	H	H	CH ₃	CH ₃
O39	H	OCO(CH ₂) ₁₄ CH ₃ β	H	H	H	H	CH ₃	CH ₃
O43	H	=O	OH α	H	H	H	CH ₃	COOH
O46	H	=O	H	H	H	OH α	CH ₃	COOH
O48	H	=O	H	H	H	OH β	CH ₃	COOH
O50	H	=O	H	H	H	H	CH ₂ OH	COOH
O55	H	=O	H	H	H	H	COOH	CH ₃
O57	H	OH α	H	H	H	OH β	CH ₃	COOH
O58	H	OH α	H	H	H	H	CH ₂ OH	COOH
O59	H	OH α	H	H	H	H	COOH	CH ₂ OH
O63	H	OH β	H	H	H	OH β	H	CH ₃
O64	H	OH β	H	H	H	OH α	CH ₃	COOH
O66	H	OH β	H	H	H	OH β	CH ₃	COOH
O68	H	OH β	H	H	H	H	CH ₂ OH	COOH
O70	H	OCOCH ₃ β	H	H	H	H	COOH	CH ₃
O71	=O	OH β	H	H	H	H	COOH	CH ₃
O73	H	OH β	H	H	H	H	COOH	CH ₃
O74	H	OH β	H	H	H	H	CH ₃	COOH
O76	H	OFeruloyl β	H	H	H	H	CH ₃	CH ₃
O79	H	=O	=O	H	H	H	CH ₃	CH ₃
O80	H	=O	H	H	H	H	CH ₃	CH ₃
O81	H	OH α	OH α	H	OH β	H	CH ₃	CH ₃
O82	H	OH α	H	H	OH β	H	CH ₃	CH ₃
O84	H	OH β	OH α	H	H	H	CH ₃	CH ₃
O85	H	OH β	H	H	H	OH β	CH ₃	CH ₃
O86	H	OH β	H	H	H	H	CH ₂ OH	CH ₃
O87	H	OH β	H	H	H	H	CH ₃	CH ₂ OH
O89	H	OCOCH ₃ β	H	H	H	H	CH ₃	CH ₃

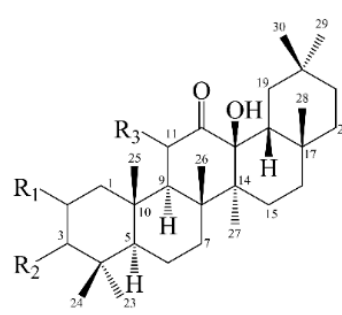
	R ₁	R ₂
O1	=O	CH ₃
O2	OH α	CH ₂ OH



	R ₁	R ₂
O9	=O	CH ₂ OH
O35	OH β	CH ₃

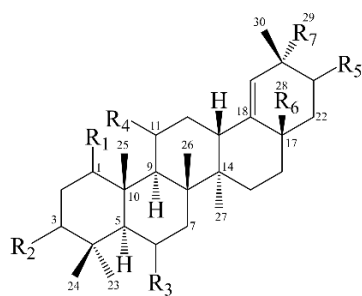


	R ₁	R ₂	R ₃
O17	OH α	OH β	OH α
O29	H	OCOCH ₃	OCOC ₆ H ₅

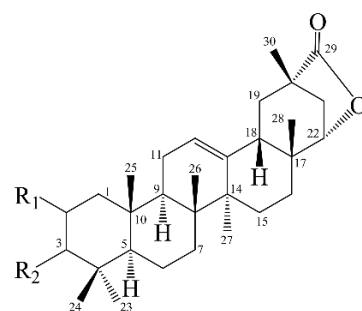


(a)

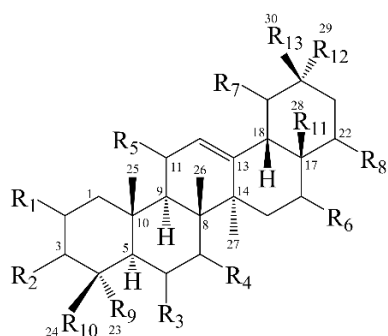
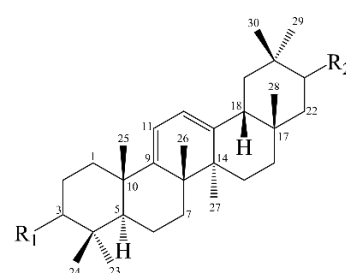
Figure 9. Cont.



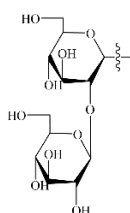
	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇
O11	H	=O	H	H	OH α	CH ₃	CH ₃
O16	H	=O	H	H	H	CH ₃	CH ₂ OH
O28	=O	OH β	H	H	H	CH ₂ OH	CH ₃
O32	H	OCO(CH ₂) ₁₆ CH ₃ β	H	H	H	CH ₃	CH ₃
O40	H	=O	OH β	H	H	CH ₃	CH ₂ OH
O41	H	=O	OH β	H	H	CH ₃	CH ₃
O90	H	=O	H	H	=O	CH ₃	CH ₃
O91	H	=O	H	H	H	CH ₃	CH ₃
O92	H	OH β	H	OH α	H	CH ₂ OH	CH ₃
O93	H	OH β	H	OH α	H	CH ₃	CH ₃
O94	H	OH β	H	H	OH α	CH ₃	CH ₃
O95	H	OH β	H	H	H	CH ₃	CH ₂ OH
O96	H	OH β	OH β	H	H	CH ₃	CH ₃
O97	H	OH β	H	H	H	CH ₃	CH ₃



	R ₁	R ₂
O20	OH α	OH β
O23	H	=O
O34	=O	OH β
O37	H	OH β



R:



	R ₁	R ₂
O31	OCaffeoyl β	H
O98	=O	H
O99	OH α	OH β
O100	OH β	H

	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈	R ₉	R ₁₀	R ₁₁	R ₁₂	R ₁₃
O18	OH α	OH β	H	H	H	H	OH α	H	CH ₃	CH ₂ OH	COOR	CH ₃	CH ₃
O19	OH α	OH β	H	H	H	H	H	H	CH ₃	CH ₂ OH	COOR	CH ₃	CH ₃
O22	H	=O	H	H	=O	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	CH ₂ OH
O42	H	=O	H	OH β	H	H	H	H	CH ₃	CH ₃	CH ₂ OH	CH ₃	CH ₃
O44	H	=O	H	H	OCH ₃ α	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	COOH
O47	H	=O	H	H	H	H	H	OH α	CH ₃	CH ₃	CH ₃	CH ₃	COOH
O49	H	=O	H	H	H	H	H	H	CH ₂ OH	CH ₃	COOH	CH ₃	CH ₃
O51	OH α	OH β	H	H	H	H	H	H	CH ₃	CH ₃	COOH	CH ₃	CH ₃
O52	H	OH	H	H	OH α	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	COOH
O54	H	=O	H	H	H	H	H	H	CH ₃	H	COOH	CH ₃	CH ₃
O56	H	=O	H	H	H	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	COOH
O60	H	OH α	H	H	H	H	H	H	CH ₃	CH ₃	COOH	CH ₃	CH ₂ OH
O61	H	OH α	H	H	H	H	H	H	COOH	CH ₃	CH ₃	CH ₃	CH ₃
O62	H	OH β	H	H	H	OH α	H	H	CHO	CH ₃	COOH	CH ₃	CH ₃
O65	H	OH β	H	H	H	H	H	OH α	CH ₃	CH ₃	CH ₃	CH ₃	COOH
O67	H	OH β	H	H	H	H	H	H	CH ₂ OH	CH ₃	COOH	CH ₃	CH ₃
O69	H	OH β	OH β	H	H	H	H	H	CH ₃	CH ₃	COOH	CH ₂ OH	CH ₃
O83	H	OH α	H	H	H	H	H	H	CH ₂ OH	CH ₃	CH ₂ OH	CH ₃	CH ₃
O88	H	OH β	H	H	H	H	H	H	CH ₃	CH ₃	CH ₃	CH ₃	CH ₂ OH

(b)

Figure 9. Cont.

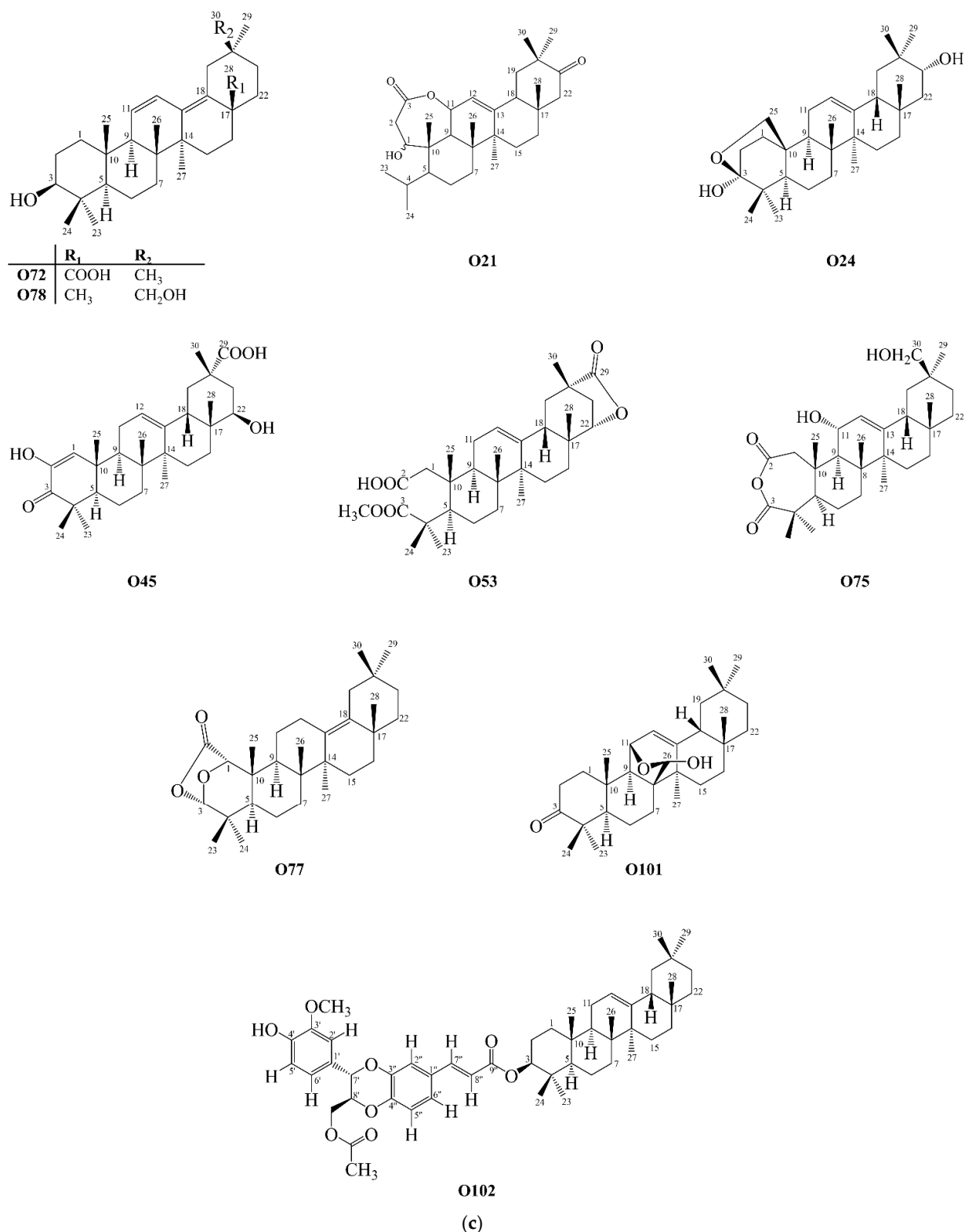
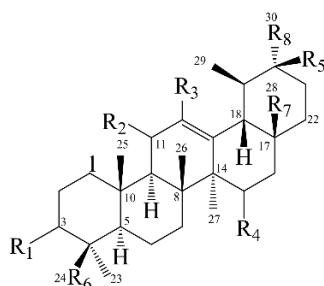
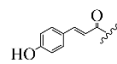


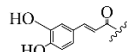
Figure 9. Structures of oleanane-type pentacyclic triterpenoids isolated from Celastraceae species (2001–2021). (a) Compounds O1–O10, O12–O15, O17, O25–O27, O29, O30, O33, O35, O36, O38, O39, O43, O46, O48, O50, O55, O57–O59, O63, O64, O66, O68, O70, O71, O73, O74, O76, O79–O82, O84–O87 and O89. (b) Compounds O11, O16, O18–O20, O22, O23, O28, O31, O32, O34, O37, O40–O42, O44, O47, O49, O51, O52, O54, O56, O60–O62, O65, O67, O69, O83, O88 and O90–O100. (c) Compounds O21, O24, O45, O53, O72, O75, O77, O78, O101, and O102.



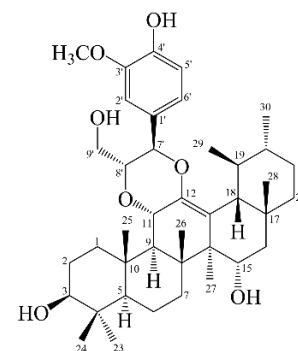
Coumaroyl:



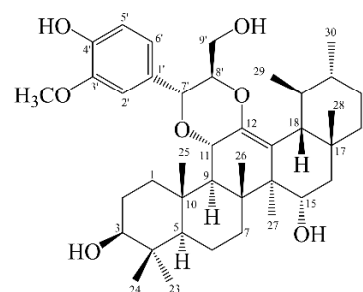
Caffeoyl:



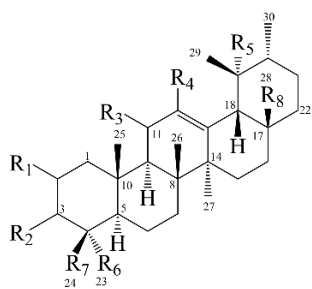
	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈
U1	=O	OH α	OH	OH α	OH β	CH ₃	CH ₃	CH ₃
U8	OH β	OCH ₃ α	OH	OH α	OH β	CHO	CH ₃	CH ₃
U12	OH β	OCH ₃ α	OH	OH α	OH β	CH ₃	CH ₃	CH ₃
U18	OH β	OCH ₃ α	H	H	H	CH ₃	CH ₂ OH	CH ₃
U22	=O	=O	OH	OH α	H	CH ₂ OH	CH ₃	COOCH ₃
U23	=O	=O	OH	OH α	OH β	CH ₃	CH ₃	CH ₃
U24	=O	=O	OH	OH α	H	CH ₂ OH	CH ₃	CH ₂ OH
U34	=O	H	H	H	H	CH ₃	CH ₂ OH	CH ₂ OH
U38	OCaffeoyl	H	H	H	H	CH ₃	CH ₂ OH	CH ₃
U39	OCoumaroyl	H	H	H	H	CH ₃	CH ₂ OH	CH ₃
U40	=O	=O	H	H	H	CH ₃	CH ₃	CH ₂ OH
U41	OH α	=O	H	H	H	CH ₃	CH ₃	CH ₂ OH
U42	OH β	OH α	OH	OH α	OH β	CHO	CH ₃	CH ₃
U54	OH β	=O	H	H	H	CH ₃	CH ₃	CH ₂ OH
U68	=O	H	H	H	H	CH ₃	CH ₂ OH	COOH
U71	=O	=O	H	H	H	CH ₃	COOH	CH ₃
U72	OH α	=O	H	H	H	CH ₃	COOH	CH ₃
U76	OCOCH ₃ α	H	H	H	H	CH ₃	COOH	CH ₃
U77	OH β	H	H	H	H	CH ₃	COOH	CH ₃
U84	OH β	H	H	H	H	CH ₃	CH ₂ OH	CH ₃



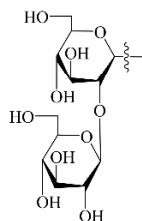
U4



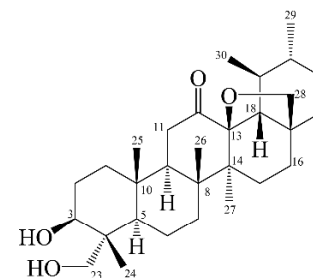
U5



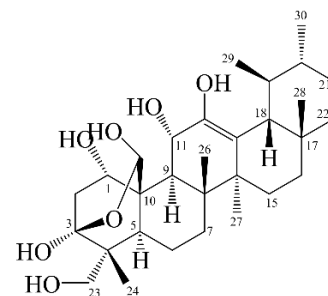
R:



	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈
U10	OH α	OH β	OCH ₃ α	OH	H	CH ₃	CH ₂ OH	CH ₃
U35	OH α	OH β	=O	OH	H	CH ₃	CH ₂ OH	CH ₃
U36	OH α	OH β	H	H	H	CH ₃	CH ₂ OH	COOR
U37	OH α	OH β	H	H	OH α	CH ₃	CH ₂ OH	COOR
U55	H	OCOCH ₃ β	OH α	H	OH α	COOCH ₃	CH ₃	CH ₂ OH
U57	H	OCOCH ₃ β	H	H	OH α	CH ₂ OH	CH ₃	CH ₂ OH
U64	H	=O	H	H	OH α	CH ₃	COOH	CH ₂ OH
U69	OH α	OH β	H	H	H	CH ₃	CH ₃	COOH
U70	OH α	=O	H	H	H	CH ₃	CH ₃	COOH
U73	H	OH β	OH α	H	OH α	COOH	CH ₃	COOH
U78	OH α	OH β	H	H	OH α	CH ₃	CH ₃	COOR



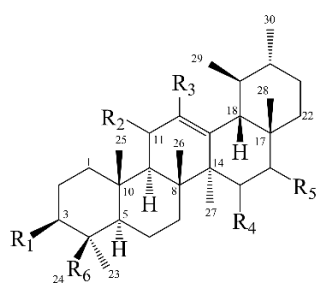
U52



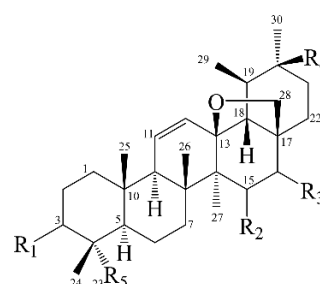
U53

(a)

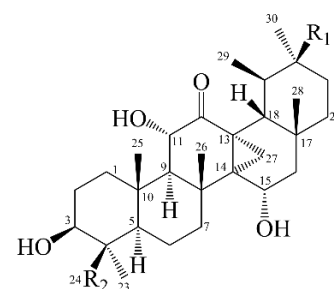
Figure 10. Cont.



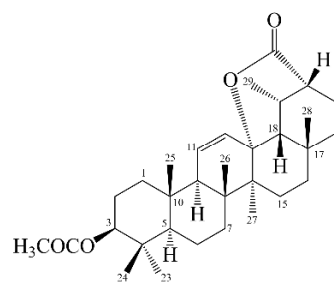
	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆
U2	=O	OH _α	OH	OH _α	H	CH ₂ OH
U3	=O	OH _α	OH	H	OH _β	CH ₃
U6	=O	OH _α	H	H	H	CH ₃
U7	=O	OCH ₃ _α	OH	OH _α	H	CH ₂ OH
U9	OH _β	OCH ₃ _α	OH	OH _α	H	CHO
U11	=O	OCH ₃ _α	H	H	H	CH ₃
U13	OH _β	OCH ₃ _α	OH	OH _α	H	CH ₂ OH
U14	OH _β	OCH ₃ _α	OH	OH _α	H	CH ₃
U15	OH _β	OCH ₃ _α	OH	H	H	CH ₂ OH
U16	OH _β	OCH ₃ _α	OH	H	H	CH ₃
U17	OH _β	OCH ₃ _α	H	OH _α	H	CH ₃
U19	OH _β	OCH ₃ _α	H	H	H	CH ₃
U20	=O	OH _β	H	H	OH _β	CH ₃
U21	=O	OH _β	H	H	H	CH ₃
U25	=O	=O	OH	OH _α	H	CH ₂ OH
U32	OH _β	OH _α	OH	OCOC ₆ H ₅ _α	H	CHO
U33	OH _β	OH _α	H	OCOC ₆ H ₅ _α	H	CH ₃
U43	OH _β	OH _α	OH	OH _α	H	CHO
U44	OH _β	OH _α	OH	OH _α	H	COOCH ₃
U48	OH _β	=O	OH	OH _α	H	CH ₂ OH
U49	OH _β	=O	OH	OH _α	H	CH ₃
U50	OH _β	=O	OH	H	H	CH ₂ OH
U51	OH _β	=O	H	H	OH _β	CH ₃
U58	OCOCH ₃ _β	H	H	H	H	CH ₃
U59	OCO(CH ₂) ₁₆ CH ₃ _β	H	H	H	H	CH ₃
U61	OH _β	=O	H	H	H	CH ₃
U62	OCO(CH ₂) ₁₄ CH ₃ _β	H	H	H	H	CH ₃
U79	=O	=O	H	H	H	CH ₃
U80	OH _β	OH _α	OH	OH _α	H	CH ₃
U81	OH _β	OH _α	OH	H	H	CH ₂ OH
U82	OH _β	OH _α	H	OH _α	H	CH ₃
U85	OH _β	H	H	H	H	CH ₃



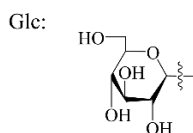
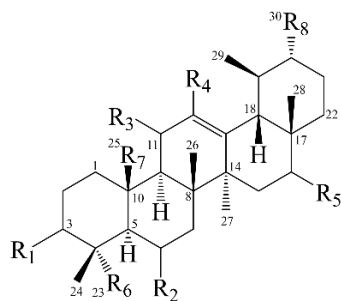
	R ₁	R ₂	R ₃	R ₄	R ₅
U27	OH _β	OH _α	H	H	CH ₃
U28	OH _β	H	OH _β	H	CH ₃
U29	OH _β	H	H	H	CH ₂ OH
U30	OH _β	H	H	H	CH ₃
U31	=O	OH _α	H	OH _β	CH ₃



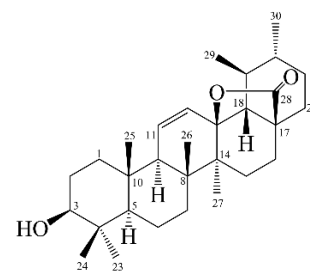
	R ₁	R ₂
U45	OH	CH ₃
U46	H	CHO
U47	H	CH ₃



U56



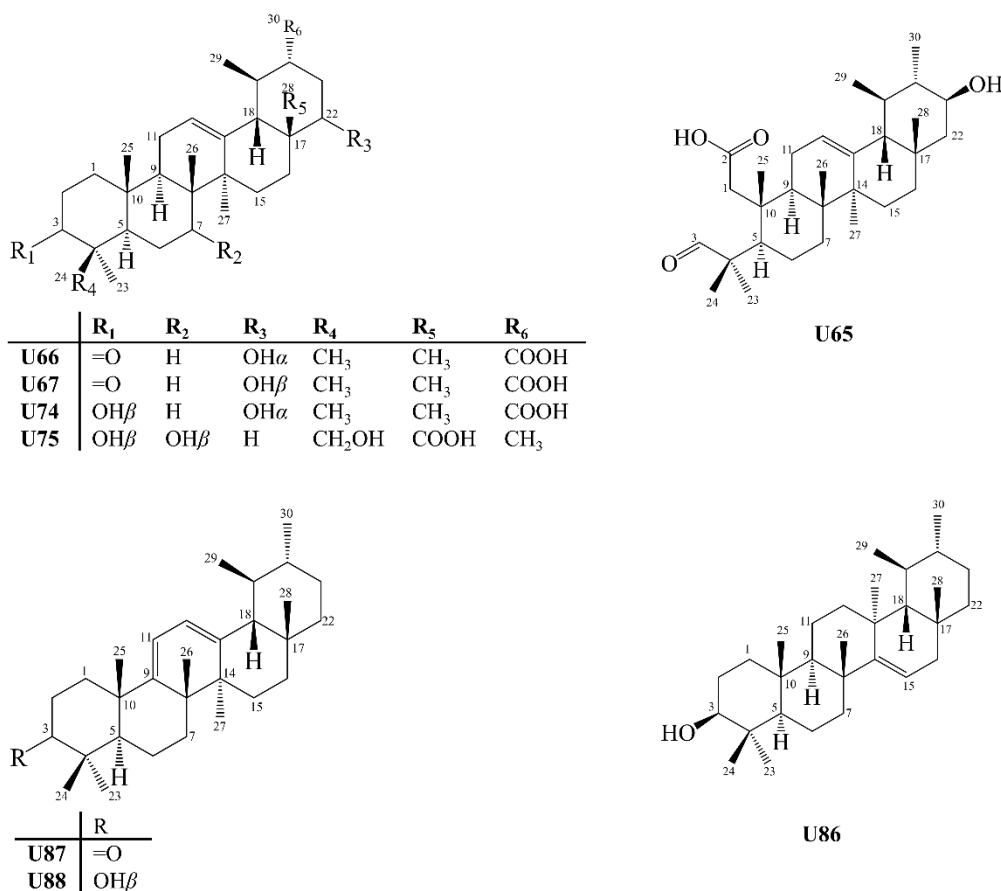
	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈
U26	OGlc _β	H	OCH ₃ _α	OH	OGlc _β	CH ₂ OH	CH ₃	CH ₃
U63	=O	OH _β	OCH ₃ _α	OH	H	CH ₂ OH	CH ₃	CH ₃
U83	OH _β	H	H	H	H	CH ₃	CH ₂ OH	CH ₂ OH



U60

(b)

Figure 10. Cont.



(c)

Figure 10. Structures of ursane-type pentacyclic triterpenoids isolated from Celastraceae species (2001–2021). (a) Compounds U1, U4, U5, U8, U10, U12, U18, U22–U24, U34–42, U52–U55, U57, U64, U68–U73, U76–U78 and U84. (b) Compounds U2, U3, U6, U7, U9, U11, U13–U17, U19–U21, U25–U33, U43–U51, U56, U58–U63, U79–U83 and U85. (c) U65–U67, U74, U75, U86–U88.

¹³C-NMR spectrum of ursanes differ from the spectrum of oleananes by the chemical shift signals of the olefinic carbon atoms, which are observed around δ_C 124 (C-12) and δ_C 139 ppm (C-13). In ursanes, the proximity of methyl group 29 with the double bond promotes a steric effect on these carbons, causing a shielding effect on C-13 and deshielding on C-12 [27,34]. This effect can be observed by comparing the ¹³C-NMR data of O3 and U6, for example. Additionally, the number of quaternary carbon signals also represents a distinction parameter between these two skeletons, since 6 signals are observed in the oleananes spectrum and 5 signals in the ursanes spectrum.

2.7. Other Triterpenoid Skeletons Isolated from Celastraceae

In addition to the PCTT types described above, other 21 types of pentacyclic structures were also isolated from Celastraceae species (Figure 11). The terpenoid skeletons are gammacerane (OT1), taraxane (OT2), hopane (OT3, OT4), glutinane (OT6, OT16, OT18, OT19), taraxerane (OT7, OT21), germanicane (OT17) and unidentified types (OT5, OT8, OT9, OT10, OT11, OT12, OT13, OT14, OT15, OT20).

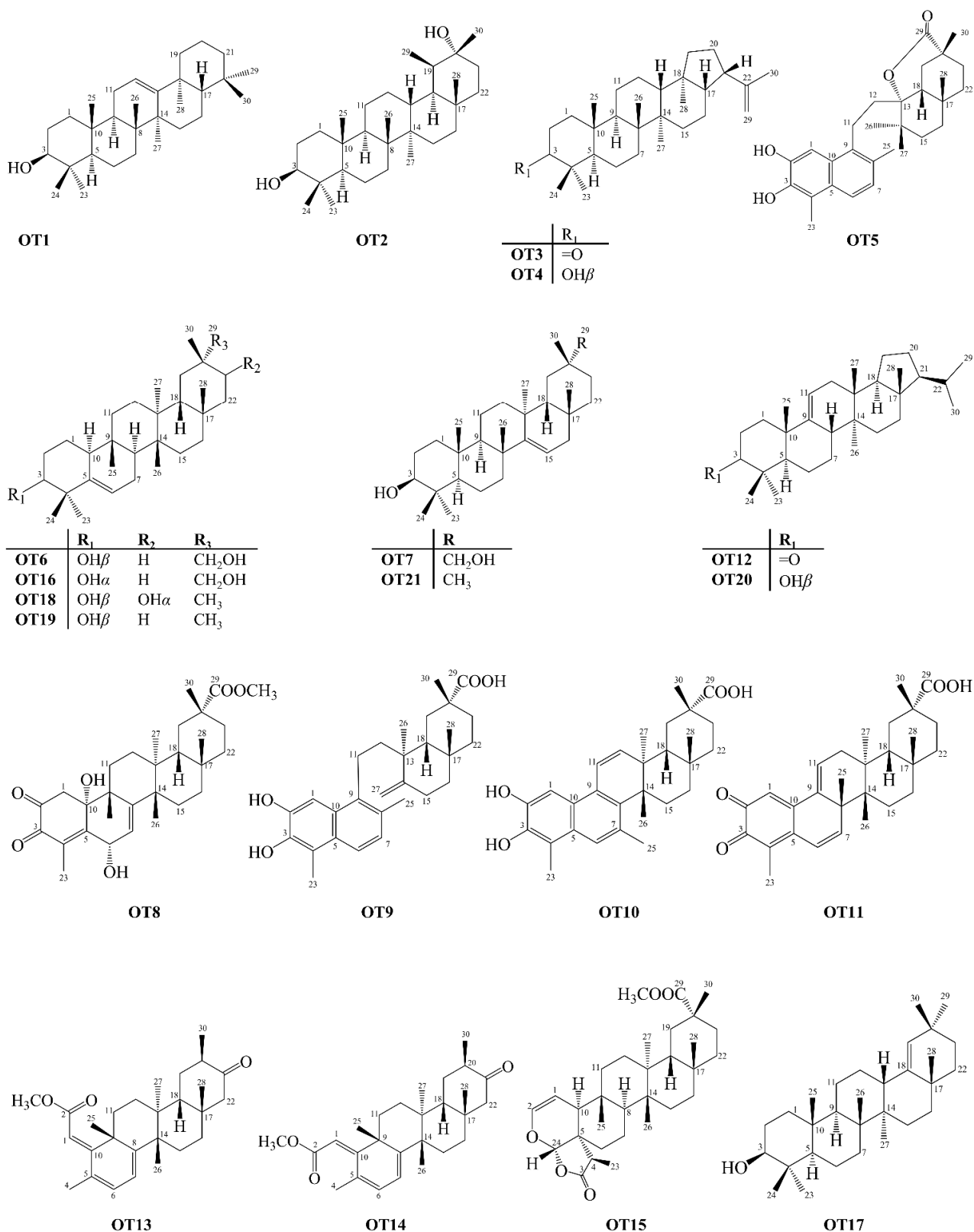


Figure 11. Structures of pentacyclic triterpenoids classified as others isolated from Celastraceae species (2001–2021).

3. ^{13}C -NMR Data of Pentacyclic Triterpenoids Isolated from Celastraceae Species (2001–2021)

Tables 1–8 list the literature ^{13}C -NMR data of the PCTTs that were isolated and characterized in the period of 2001–2021.

Table 1. ^{13}C -NMR data of friedelane-type pentacyclic triterpenoids isolated from Celastraceae species (2001–2021).

C	F1	F2	F3	F4 ^a	F6 ^b	F7	F8 ^b	F9	F10	F11
1	25.0	22.3	22.3	22.3	22.8	22.3	202.8	22.2	202.4	22.8
2	41.6	41.4	41.2	41.4	42.7	41.5	60.6	41.4	60.4	41.9
3	213.3	212.7	212.3	212.7	211.9	213.0	204.0	213.0	203.8	212.1
4	52.1	58.1	58.0	58.1	57.8	58.2	58.9	58.1	58.6	58.3
5	43.1	41.8	41.8	41.9	42.4	42.0	38.1	42.0	37.4	42.4
6	42.2	41.1	40.8	41.2	41.7	41.3	41.5	41.1	40.2	41.5
7	17.9	18.3	18.4	18.1	22.7	20.0	20.4	18.3	17.9	18.9
8	52.8	51.3	52.0	52.9	54.4	53.5	52.4	49.9	48.8	50.8
9	44.1	38.3	38.1	38.2	38.0	37.8	37.1	37.4	36.6	38.0
10	60.1	59.3	59.1	59.4	59.8	59.4	72.3	59.5	71.5	59.8
11	76.9	47.0	47.3	47.4	37.1	35.6	34.9	34.9	33.7	35.6
12	42.0	72.1	71.2	72.7	31.6	31.2	29.9	29.3	29.1	30.4
13	41.1	44.8	45.7	45.3	41.0	40.6	39.7	39.9	39.3	39.9
14	38.2	41.1	40.8	40.4	46.8	44.1	42.9	39.2	38.8	40.2
15	32.4	31.6	50.3	33.4	75.5	74.6	31.3	36.8	38.7	40.2
16	35.9	35.9	218.3	36.1	48.4	48.4	78.1	74.3	75.5	75.7
17	30.0	31.3	45.7	30.8	30.9	30.2	35.0	41.0	37.0	37.7
18	42.5	44.3	45.4	44.2	42.6	41.6	45.5	41.7	45.6	46.66
19	35.4	31.7	38.5	38.4	32.2	35.6	35.7	33.7	33.8	34.3
20	28.1	33.3	27.8	28.4	28.4	28.1	28.1	28.0	27.7	28.6
21	32.7	29.9	31.5	32.7	36.2	31.9	31.8	33.8	33.2	35.0
22	39.2	38.1	30.7	39.6	39.5	38.7	34.9	19.8	26.2	27.8
23	6.9	6.8	6.8	6.8	7.2	6.8	7.3	6.7	7.0	7.5
24	14.8	14.6	14.6	14.6	14.4	14.5	15.8	14.7	15.7	15.1
25	12.9	19.2	18.7	19.3	16.9	17.9	18.2	19.2	18.8	19.4
26	20.1	18.7	20.5	20.5	65.8	14.0	63.2	16.5	16.8	17.7
27	19.5	11.6	9.0	11.6	19.7	18.7	20.9	19.7	19.1	20.0
28	32.0	31.7	27.3	31.8	32.7	32.6	25.9	71.3	29.9	31.0
29	31.7	71.6	31.3	34.9	35.7	30.9	37.8	37.0	31.8	32.7
30	35.0	29.2	35.0	31.9	31.0	35.6	30.4	31.8	36.2	36.9
C=O							171.3			
OCH ₃							21.3			
Ref	[35]	[36]	[37]	[38]	[39]	[40]	[41]	[42]	[43]	[44]
C	F12 ^a	F13	F14 ^b	F15 ^a	F16	F17	F18	F19	F20	F21
1	21.7	22.2	22.3	68.8	75.8	74.0	71.4	202.7	22.3	22.3
2	40.9	41.4	41.6	51.9	35.0	30.1	52.7	60.6	41.5	41.3
3	211.1	212.8	212.5	210.4	212.3	213.2	211.3	204.1	213.2	212.7
4	57.4	58.0	58.3	57.5	55.9	53.3	59.1	59.1	58.2	58.1
5	41.5	42.1	42.3	39.4	43.3	42.7	43.9	37.8	42.0	41.8
6	40.5	41.1	41.4	41.8	41.8	41.2	34.3	40.6	41.2	40.2
7	18.0	18.4	18.6	17.8	17.9	18.2	18.8	18.1	18.0	21.2
8	53.0	53.3	53.5	53.4	53.8	53.0	53.9	50.6	51.2	44.7
9	36.9	37.4	37.6	36.6	42.0	36.9	38.6	37.3	37.5	37.9
10	58.7	59.3	59.7	64.8	57.4	52.4	62.6	71.9	59.5	59.0
11	35.1	35.6	35.8	37.0	30.2	35.9	35.7	34.2	35.3	36.8
12	30.0	30.7	30.8	29.9	31.0	30.5	30.4	29.8	30.2	33.9
13	39.6	40.1	39.3	39.4	39.8	39.8	39.8	38.8	39.0	47.5
14	38.8	39.1	40.1	39.3	37.5	38.4	38.5	38.7	38.8	56.3
15	44.7	44.3	44.4	33.2	32.7	32.1	32.7	30.5	30.4	213.3

Table 1. Cont.

16	75.7	74.4	75.6	36.0	36.0	35.4	36.2	35.9	36.1	53.8
17	40.5	36.4	32.1	30.4	29.9	30.0	30.2	32.5	32.5	34.0
18	39.9	44.1	44.8	41.9	42.7	42.7	43.0	44.2	44.3	45.3
19	29.3	30.4	35.8	30.8	35.3	28.9	35.5	36.0	35.9	38.9
20	32.7	33.1	28.0	33.2	28.1	33.4	28.2	34.3	34.4	28.0
21	27.7	27.5	32.1	27.8	32.7	28.2	33.0	74.3	74.3	71.7
22	29.5	36.4	36.0	39.7	39.3	28.1	39.3	47.0	47.0	46.3
23	6.4	6.9	6.8	7.1	6.7	6.9	6.9	7.3	6.8	6.8
24	14.0	14.6	14.7	16.0	14.7	14.3	17.4	16.0	14.6	14.9
25	17.5	18.1	18.2	18.4	63.0	17.9	19.2	18.2	17.7	18.9
26	21.1	20.1	20.1	18.6	20.1	20.0	20.2	17.8	18.2	15.4
27	19.3	21.4	21.5	21.0	18.6	18.7	18.7	19.3	19.3	12.1
28	66.7	25.4	24.9	32.1	32.2	32.2	32.2	33.1	33.2	31.5
29	74.0	74.4	30.8	74.5	35.0	28.9	31.8	24.9	31.9	31.4
30	25.4	25.7	35.5	25.9	31.7	72.0	34.9	31.8	24.9	33.8
Ref	[45]	[46]	[27]	[45]	[47]	[48]	[48]	[49]	[50]	[51]
C	F22	F23	F24	F25	F26	F27	F28^b	F29	F30	F31
1	22.4	202.8	24.7	24.6	202.8	22.5	22.4	22.3	202.7	22.1
2	41.6	60.5	42.6	42.5	60.6	41.6	41.6	41.5	60.6	41.3
3	213.2	230.7	212.9	212.8	204.1	213.3	211.7	212.9	204.1	213.6
4	58.4	59.7	58.5	58.5	58.9	58.4	57.9	58.3	59.0	57.8
5	42.4	37.5	42.4	42.4	38.1	42.3	42.1	42.1	37.2	41.9
6	41.4	38.5	41.8	41.7	41.7	41.5	41.2	41.4	40.6	41.0
7	18.4	17.0	17.9	18.0	20.4	18.6	18.4	18.3	18.0	18.1
8	53.4	45.2	53.7	53.9	52.0	53.8	53.2	53.5	51.5	52.2
9	37.6	37.1	42.0	42.0	37.1	37.6	37.5	37.5	37.8	37.3
10	59.6	69.0	60.7	60.7	72.4	59.7	59.2	59.6	71.9	59.1
11	35.8	35.8	29.9	30.0	35.0	37.8	35.7	35.5	33.4	35.3
12	30.8	26.5	31.2	31.4	29.9	24.1	30.5	30.0	29.7	29.9
13	39.8	38.1	39.7	39.9	39.7	45.4	40.1	39.6	39.2	39.1
14	38.4	40.0	37.7	37.9	42.0	38.4	38.2	38.4	39.1	38.0
15	32.5	34.7	32.7	33.0	20.1	32.2	29.5	31.1	31.2	31.3 *
16	38.8	36.8	36.0	35.0	35.3	36.2	32.6	29.2	29.0	29.0
17	30.0	30.8	30.1	33.1	30.4	30.3	36.6	35.1	35.1	35.1
18	42.8	44.0	42.7	41.9	43.5	43.3	39.0	38.9	39.3	39.2
19	36.0	35.4	35.3	37.0	35.4	37.1	29.8	31.5	34.4	34.4
20	33.9	28.3	28.1	42.7	28.3	28.5	33.6	33.3	28.1	27.9
21	75.8	32.5	32.7	218.7	32.9	32.6	29.2	30.2	31.4	31.4 *
22	48.6	38.9	39.2	55.0	39.1	40.1	33.0	28.3	34.3	33.2
23	6.9	7.5	7.0	7.0	7.3	7.1	7.2	6.8	7.3	6.7
24	14.8	15.7	14.7	14.7	15.7	14.9	14.7	14.7	15.9	14.5
25	18.0	67.1	63.0	62.7	17.8	18.2	18.0	18.2	18.1	18.0
26	20.8	69.9	20.1	20.9	64.0	22.3	20.1	18.6	19.1	18.9
27	18.9	19.3	18.5	18.4	19.7	63.4	19.0	19.1	19.2	19.1
28	34.5	30.0	32.1	33.6	31.7	32.8	67.1	69.0	68.0	67.0
29	34.9	31.4	35.0	28.8	34.5	35.8	73.6	28.6	34.2	32.9
30	24.1	35.1	31.7	25.0	32.0	30.6	27.5	73.4	32.8	34.2
Ref	[52]	[53]	[48]	[54]	[41]	[55]	[56]	[57]	[58]	[57]
C	F32	F34	F35	F36	F37	F38	F39^c	F40	F41	F42
1	22.7	22.2	22.5	25.9	32.4	31.7	28.2	24.8	202.7	22.3
2	41.4	41.3	41.6	75.4	76.9	74.4	71.0	42.6	60.6	41.5
3	213.4	212.2	212.8	105.6	212.0	209.7	199.6	212.3	204.1	212.9
4	58.6	57.9	58.6	47.4	52.7	52.4	127.1	58.6	59.1	58.3
5	42.3	42.0	42.4	46.8	42.7	54.2	158.8	42.3	37.8	42.1
6	41.9	40.8	41.7	33.3	40.8	36.7	30.4	41.6	40.6	41.4
7	18.4	18.5	18.5	19.2	17.5	19.4	20.3	18.2	18.0	18.3
8	53.2	52.3	53.7	49.8	52.7	49.6	47.3	54.0	52.0	53.1

Table 1. Cont.

9	38.0	37.5	37.8	37.1	38.0	37.5	37.2	41.1	37.2	37.5
10	59.6	59.0	59.9	53.2	52.7	55.7	51.8	60.3	71.9	59.6
11	35.7	35.2	36.0	34.3	35.6	34.5	32.4	30.1	34.5	35.7
12	31.0	28.9	30.8	29.0	30.2	29.4	28.9	30.7	30.1	29.4
13	37.6	39.0	38.6	39.2	39.4	40.2	39.2	39.9	39.6	39.9
14	39.3	40.6	40.3	39.1	38.9	39.4	39.5	37.9	38.3	38.2
15	28.6	50.2	33.0	29.1	32.7	28.3	27.9	33.1	32.1	32.2
16	32.8	218.4	36.2	36.2	36.5	29.6	35.1	34.9	35.8	29.7
17	48.6	45.7	30.8	30.1	29.8	44.8	37.7	33.0	30.0	30.0
18	35.9	43.2	42.3	44.5	42.4	45.4	43.4	41.8	42.6	42.9
19	29.8	30.1	39.8	30.4	35.0	31.6	31.3	36.9	29.4	30.6
20	33.7	32.7	33.4	40.6	27.8	41.4	41.9	42.7	33.4	33.4
21	28.0	27.0	30.0	30.0	32.0	214.2	213.7	218.7	28.1	28.3
22	33.7	31.1	28.1	36.6	40.8	77.5	53.3	55.0	38.1	39.9
23	7.2	6.9	7.0	7.1	6.3	7.9	10.7	7.0	7.3	6.8
24	15.0	14.6	14.9	72.4	13.8	174.2		14.8	16.0	14.7
25	17.5	17.2	18.1	16.7	17.9	16.8	17.0	65.1	18.1	18.0
26	20.5	20.3	18.6	16.2	18.4	15.5	15.0	21.5	20.0	18.6
27	19.2	15.9	20.9	17.5	19.9	19.4	17.9	18.6	18.6	19.9
28	208.9	27.4	32.3	31.9	32.1	25.4	32.3	33.8	32.1	32.2
29	24.4	74.1	75.0	179.4	31.7			28.8	28.9	29.0
30	74.7	25.8	26.1	32.1	34.7	15.0	14.7	25.0	72.0	72.1
OCH ₃						51.7				
C=O								166.8		
<i>Iso</i>								130.2		
<i>Orto</i>								129.5		
<i>Meta</i>								128.6		
<i>Para</i>								133.1		
Ref	[48]	[46]	[59]	[48]	[60]	[61]	[62]	[54]	[49]	[57]
C	F43	F44	F45	F47	F49	F50	F51	F52	F53	F54
1	31.3	200.5	27.6	22.2	22.3	39.0	36.1	26.7	26.7	210.9
2	193.1	102.6	41.2	41.5	41.5	211.4	211.7	72.7	73.2	53.9
3	146.5	175.5	213.0	213.0	213.0	77.2	77.0	106.3	106.8	75.4
4	126.9	49.9	57.9	58.2	58.2	54.8	54.6	45.6	45.7	50.0
5	54.7	41.6	41.7	42.1	42.1	38.0	38.1	52.8	47.0	44.5
6	30.7	41.1	40.7	41.2	41.3	41.1	40.7	72.8	33.6	42.7
7	18.4	17.6	17.8	18.0	18.2	17.3	17.6	30.4	19.2	18.2
8	49.4	52.3	51.5	52.8	50.4	53.8	53.2	46.5	49.7	53.2
9	37.0	37.1	37.4	37.1	37.5	41.8	37.7	37.0	37.0	37.2
10	55.8	68.7	59.0	59.2	59.6	60.8	60.5	52.7	52.6	71.8
11	33.1	35.3	34.8	35.4	35.2	29.5	35.1	34.0	34.1	35.2
12	29.2	30.4	30.4	30.6	30.5	30.5	20.3	29.7	29.0	30.9
13	39.2	39.4	37.5	38.7	39.3 *	39.7	39.7	39.2	39.1	40.6
14	39.1	38.3	38.4	37.6	39.4 *	38.2	38.4	38.9	49.1	38.8
15	28.9	32.5	32.6	32.4	30.0	32.7	32.4	29.1	29.0	33.3
16	36.0	36.0	29.3	34.9	36.2	35.9	36.0	36.1	36.2	36.6
17	30.1	29.9	42.4	47.7	30.2	30.0	30.0	30.5	30.1	31.1
18	44.4	42.7	38.5	36.4	44.6	42.6	42.9	44.5	44.5	42.6
19	30.4	35.1	34.1	35.4	29.2	35.3	35.4	30.1	30.4	30.7
20	40.5	28.2	32.8	28.3	40.6	28.1	28.2	40.5	40.5	34.0
21	29.9	32.8	31.0	32.4	29.6	32.7	32.8	30.0	30.0	28.7
22	36.5	39.3	22.0	28.0	36.6	39.2	39.3	36.5	36.4	40.5
23	10.6	8.5	6.6	6.8	6.8	10.9	10.8	9.9	6.9	12.4
24	194.9	15.1	14.3	14.6	14.6	14.0	14.2	64.6	72.2	18.4
25	17.4	18.1	17.0	17.2	17.5	63.7	17.4	16.5	16.7	19.0
26	15.9	20.4	19.0	20.0	18.5	20.3	20.2	16.1	16.1	21.3
27	17.2	18.7	16.1	18.8	16.1	18.5	18.5	1.4	17.4	19.1
28	31.8	32.0	177.0	209.1	31.9	32.2	31.1	31.8	31.8	32.7

Table 1. Cont.

29	179.1	35.0	26.7	34.5	179.3	35.0	31.8	179.1	179.1	74.7
30	31.9	31.7	79.7	29.4	31.9	31.7	35.0	32.0	32.0	26.9
OCH ₃	51.5	55.6			51.5					
Ref	[63]	[64]	[48]	[65]	[66]	[47]	[67]	[68]	[48]	[69]
C	F55	F56	F57	F59^b	F60	F61	F62	F63	F64^b	F65^c
1	21.7	29.6	146.3	35.6	21.9	22.3	22.4	74.0	28.7	26.6
2	37.1	72.4	130.1	41.1	41.2	41.7	41.7	29.7	74.2	68.5
3	216.6	202.3	200.9	212.4	212.4	212.8	212.7	231.2	108.1	71.2
4	58.7	129.5	57.7	58.1	58.2	58.8	58.8	53.3	46.8	42.8
5	39.9	157.8	49.1	42.5	42.6	41.3	41.3	42.7	47.5	49.0
6	37.4	65.4	77.2	50.4	52.2	49.0	48.9	41.2	34.0	37.2
7	17.7	29.9	28.7	69.2	68.6	68.4	68.3	18.1	19.7	19.0
8	53.5	40.9	48.2	58.2	58.6	52.9	52.6	53.1	50.4	49.2
9	37.0	38.5	36.7	38.8	39.0	37.2	37.6	36.9	37.5	44.0
10	49.4	48.9	60.3	59.3	58.9	60.0	59.8	52.4	53.3	50.0
11	35.7	33.4	45.4	36.0	35.9	37.6	31.2	32.7	34.7	33.8
12	30.5	29.5	69.3	29.9	29.6	30.5	37.5	29.5	29.5	28.8
13	39.7	39.3	40.0	40.3	40.3	40.4	39.5	39.7	39.6	39.6
14	38.3	40.6	45.6	44.2	40.0	39.1	44.9	38.0	39.3	38.8
15	32.4	28.3	49.6	27.0	29.5	32.4	32.8	30.2	29.7	27.8
16	36.0	29.8	214.2	35.5	38.3	35.8	29.1	35.3	36.7	28.9
17	30.0	45.2	47.1	30.1	30.4	30.5	38.3	30.0	30.5	36.4
18	42.7	45.8	44.7	43.3	42.3	41.6	38.0	42.4	44.8	45.0
19	35.3	32.0	39.6	21.9	35.3	29.6	35.1	31.3	30.9	30.9
20	28.1	41.7	42.3	28.3	33.5	33.1	28.5	40.2	40.7	40.8
21	32.7	214.1	218.1	32.4	27.9	27.9	35.9	28.2	30.5	213.2
22	39.2	78.1	47.2	39.2	36.1	39.4	32.5	38.2	37.4	76.7
23	13.5	11.1	9.8	6.9	6.9	6.9	6.9	6.8	8.4	11.3
24	23.1		8.7	15.9	15.9	16.1	16.1	14.4	72.1	176.5
25	18.0	17.0	19.6	18.8	18.9	19.0	18.8	17.5	16.9	15.2
26	20.4	15.8	19.9	64.2	13.1	21.8	21.4	20.9	16.8	17.3
27	18.7	19.3	8.7	20.1	20.8	18.3	18.5	17.7	18.1	18.6
28	32.1	25.9	29.1	31.2	31.8	32.1	179.2	32.0	32.1	25.5
29	35.0		28.4	34.7	29.1	74.5	34.4	31.8	181.3	
30	31.7	15.4	24.4	31.1	71.3	26.0	29.6	183.1	32.3	14.9
Ref	[70]	[71]	[72]	[39]	[73]	[48]	[48]	[48]	[74]	[75]
C	F66	F67⁺	F68	F69^b	F70^b	F71	F72	F73	F74	F75^b
1	30.8	28.2	32.6	30.9	39.0	22.3	22.2	22.3	36.5	20.3
2	74.1	76.5	75.0	193.5	194.6	41.5	42.0	41.5	212.3	38.9
3	213.3	208.1	212.4	149.0	144.2	213.2	213.3	213.3	77.3	105.9
4	52.7	54.3	55.6	125.8	139.9	58.2	58.2	58.3	54.8	53.7
5	43.1	43.1	43.1	54.9	40.0	42.1	44.7	42.0	39.6	47.0
6	41.3	41.0	41.2	32.7	33.6	41.2	41.5	41.3	40.9	33.9
7	18.5	18.2	18.1	18.9	18.2	18.2	18.4	18.2	17.9	19.4
8	50.9	50.4	53.2	49.5	50.8	53.1	52.9	50.7	51.0	50.0
9	37.2	36.6	37.4	37.1	37.8	37.5	37.7	37.4	38.3	37.3
10	52.6	53.3	56.5	55.5	56.1	59.4	59.2	59.8	60.9	57.1
11	35.4	35.1	35.3	33.3	35.0	35.6	35.9	36.1	35.0	34.6
12	30.5	30.1	30.2	30.9	30.7	30.3	31.0	29.5	29.7	29.4
13	39.5	39.2	39.7	39.4	39.7	39.7	41.0	39.2	38.0	39.4
14	39.7	39.3	38.1	39.6	39.8	38.0	38.8	39.1	39.5	39.2
15	29.8	30.4	32.8	30.5	30.6	32.8	29.3	29.4	30.1	29.3
16	37.8	36.2	35.4	36.6	36.8	35.4	32.6	36.6	36.5	36.5
17	30.4	29.1	29.6	30.5	31.2	29.5	37.6	30.1	30.5	30.3
18	44.8	44.5	42.5	44.8	45.0	42.5	37.6	44.2	44.7	44.6
19	30.8	36.9	31.3	29.5	29.9	31.2	35.4	29.3	30.6	30.7
20	40.7	40.6	40.3	40.7	40.9	40.3	28.4	40.4	40.6	40.5
21	29.7	29.9	28.2	29.4	30.1	28.2	34.8	30.2	29.7	30.3

Table 1. Cont.

22	36.7	29.4	38.2	37.4	37.2	38.2	32.6	35.2	37.1	37.2
23	6.8	6.5	6.5	10.7	10.5	6.8	6.8	6.9	11.2	8.4
24	14.2	14.1	14.7	195.8	19.1	14.6	14.6	14.6	14.6	72.9
25	18.0	18.3	17.8	17.2	18.2	17.7	17.5	18.4	18.1	16.7
26	18.5	16.1	20.9	17.9	18.5	20.9	20.7	16.3	18.2	17.9
27	16.1	17.5	17.7	16.2	17.0	17.7	18.5	18.0	16.6	16.5
28	32.1	31.8	31.8	32.3	32.0	32.0	185.0	31.8	32.2	31.9
29	181.2	31.9	183.3	181.5	181.2	31.9	29.7	184.8	32.1	181.2
30	32.1	179.4	32.0	32.1	32.3	184.7	34.5	31.5	182.4	32.2
COOCH_3		179.4								
COOCH_3		51.6								
COOCH_3		169.8								
COOCH_3		21.2								
Ref	[76]	[77]	[78]	[59]	[79]	[80]	[56]	[81]	[82]	[83]
C	F76	F77^c	F79	F80	F81	F82	F83	F84	F85	F86
1	19.3	26.6	22.4	16.0	148.2	202.7	202.8	22.2	22.3	22.3
2	36.3	67.6	41.7	35.4	130.4	60.6	60.6	40.8	41.1	41.4
3	71.9	83.1	212.7	73.0	201.5	204.0	204.2	212.1	212.1	213.1
4	52.9	43.3	58.8	49.4	57.6	59.0	59.1	57.9	58.1	58.2
5	37.4	48.6	41.3	38.0	43.7	37.8	37.8	42.2	42.2	42.0
6	40.9	33.3	48.9	41.9	39.5	40.5	40.6	41.0	41.0	40.5
7	17.4	18.7	68.3	17.7	18.1	18.1	18.1	18.4	18.6	21.3
8	52.6	49.6	52.9	53.7	51.5	52.4	52.2	53.0*	53.1	45.3
9	37.0	36.8	37.6	37.3	36.8	37.2	37.2	55.5	43.8	37.2
10	59.6	52.2	59.8	61.5	61.9	71.8	71.9	53.1*	59.3	59.3
11	35.6	33.7	31.1	35.8	34.4	34.5	34.6	214.2	51.4	34.4
12	30.9	28.7	37.8	30.9	28.8	30.3	30.2	51.2	214.2	29.4
13	37.8	38.6	39.5	40.1	39.0	39.7	39.5	44.0	55.5	42.4
14	38.6	38.6	44.6	38.5	40.5	38.1	38.2	43.8	44.0	54.2
15	32.3	29.4	32.8	32.8	49.8	32.7	32.4	31.6	35.6	214.9
16	29.2	35.9	29.2	36.1	218.7	35.0	35.9	36.1	36.2	54.0
17	44.5	29.7	38.4	30.7	45.3	33.2	30.0	29.6	29.7	33.5
18	37.6	44.0	38.4	42.0	43.9	41.8	42.7	36.4	36.6	44.0
19	34.5	29.7	35.1	29.9	35.4	37.0	35.3	35.4	31.7	34.9
20	28.2	40.6	28.5	33.3	27.6	42.8	28.2	28.3	28.4	27.9
21	35.1	29.4	35.8	28.0	31.6	218.8	32.8	33.0	33.1	33.8
22	32.2	36.3	32.4	39.7	30.7	55.0	39.3	38.9	39.1	38.6
23	9.6	14.3	6.9	11.8	6.7	7.3	7.3	6.8	6.9	6.8
24	14.3	96.5	16.1	16.6	13.7	16.0	16.0	14.5	14.6	15.0
25	17.4	16.3	18.8	18.4	19.1	17.8	18.0	18.1	18.2	17.4
26	20.3	16.1	21.7	20.8	19.8	21.3	20.3	19.0	19.9	14.7
27	18.3	17.2	18.5	18.7	16.2	18.5	18.7	19.8	19.1	18.9
28	183.7	31.7	183.3	32.3	27.4	33.5	32.0	31.8	31.9	32.2
29	29.5	179.6	34.3	75.0	35.2	28.8	31.8	31.7	31.8	33.3
30	34.2	31.6	29.7	26.0	31.1	25.0	35.0	34.2	34.3	33.4
Ref	[48]	[84]	[48]	[69]	[45]	[52]	[85]	[86]	[35]	[51]
C	F87	F88	F89	F90	F91^b	F92	F93^a	F94	F95	F96
1	22.2	21.6	22.2	18.6	17.0	16.0	16.2	41.3	27.8	31.4
2	41.4	40.8	41.4	35.4	40.3	35.5	36.1	41.6	170.4	193.2
3	212.5	210.6	212.8	72.0	74.7	72.0	71.6	213.0	177.0	146.5
4	58.2	57.8	58.1	49.4	49.1	49.4	49.6	59.5	47.3	127.0
5	42.1	47.0	42.0	38.3	41.4	37.9	38.1	42.2	38.9	54.7
6	41.0	56.9	41.2	41.9	36.0	41.8	42.0	35.6	34.5	30.6
7	18.6	210.2	18.1	17.5	19.3	17.7	17.7	30.7	17.1	18.3
8	52.4	63.4	53.0	52.9	53.8	53.2	53.3	53.4	52.0	48.7
9	37.7	42.4	37.4	43.9	36.8	37.1	37.2	37.5	35.3	37.0
10	59.4	59.0	59.4	62.3	61.6	61.5	61.6	58.2	46.1	56.0
11	35.4	35.5	35.5	76.6	36.5	35.5	35.7	22.4 *	32.0	33.3

Table 1. Cont.

12	29.1	29.8	30.4	42.0	31.4	30.3	30.7	32.9	30.1	28.8
13	39.2	39.4	39.6	38.5	37.6	39.7	38.4	38.3	39.6	40.7
14	40.5	37.5	38.2	40.9	39.9	38.0	39.7	40.0	38.0	39.5
15	50.2	31.6	32.2	32.3	32.5	32.3	32.3	18.4 *	32.3	28.2
16	218.8	36.3	35.9	36.0	35.6	32.0	35.9	37.1	35.7	35.9
17	45.3	30.1	29.9	30.0	30.7	36.1	30.0	42.8	30.0	31.4
18	44.0	41.8	42.8	42.6	43.6	38.5	42.9	42.0	42.6	45.3
19	35.5	34.9	35.2	35.7	35.6	29.3	35.4	35.1	35.2	29.8
20	27.6	28.0	28.0	28.1	28.8	33.1	28.2	33.3	28.1	149.1
21	31.7	32.8	32.7	32.8	32.9	28.4	32.9	218.8	32.6	30.7
22	30.8	38.6	39.2	39.2	39.0	28.7	39.3	55.1	39.1	38.0
23	6.8	6.8	6.7	12.1	14.8	11.9	12.1	6.9	12.5	10.7
24	14.7	15.1	14.5	16.7	65.8	16.5	16.6	17.9	20.6	194.9
25	17.3	18.2	17.8	13.5	18.4	18.3	18.3	14.8	72.6	18.1
26	20.3	19.2	18.5	19.9	18.9	20.0	20.1	33.6	20.2	15.1
27	16.2	19.4	20.1	19.5	20.8	18.8	18.7	21.4	18.5	17.9
28	27.4	32.1	32.0	32.0	33.6	66.7	32.1	18.6	32.1	31.4
29	31.1	31.8	31.7	35.0	35.6	73.8	35.0	25.1	35.0	
30	35.2	34.6	34.9	31.7	32.7	26.5	31.8	28.9	31.6	107.6
Ref	[57]	[57]	[57]	[87]	[88]	[69]	[89]	[90]	[47]	[91]
C	F97^C	F98	F99	F100	F101	F102	F103			
1	26.9	22.0	28.7	19.1	21.3	21.1	116.0			
2	105.0	41.2	71.5	34.5	38.0	37.2	166.1			
3	77.1	212.8	200.1	175.6	176.2	177.8				
4	47.7	57.9	127.7	36.1	35.8	36.2	197.9			
5	44.6	41.9	159.2	36.8	37.5	37.9	135.5			
6	30.1	41.0	30.9	38.8	38.7	39.0	136.0			
7	18.6	18.0	20.8	18.0	17.9	18.2	118.6			
8	48.1	53.1	47.7	52.6	52.1	53.1	163.3			
9	37.5	37.2	37.6	42.9	38.8	39.1	39.2			
10	52.1	59.2	52.3	58.2	59.6	59.9	165.9			
11	33.3	35.3	33.1	84.1	34.7	35.3	31.2			
12	28.8	29.8	29.5	37.6	29.5	30.3	29.2			
13	40.2	38.0	39.5	40.7	39.0	39.7	38.3			
14	39.1	39.6	40.0	37.9	37.9	38.4	47.6			
15	28.3	32.3	28.1	32.1	31.1	32.4	28.5			
16	29.6	35.5	29.7	35.9	29.0	36.1	36.6			
17	44.8	30.1	44.9	30.0	35.0	30.1	30.4			
18	45.6	41.6	45.3	42.6	39.3	43.0	44.6			
19	31.7	30.3	31.7	35.3	34.3	35.4	31.1			
20	41.5	31.4	41.3	28.1	27.8	28.2	40.4			
21	213.9	27.7	214.0	32.7	33.2	32.9	29.7			
22	77.4	38.8	77.2	39.2	31.3	39.3	34.4			
23	16.1	6.6	11.2	7.7	7.3	7.6	18.1			
24	175.3	14.4		22.1	19.2	19.5				
25	16.6	17.6	15.6	13.6	17.8	18.0	25.6			
26	15.8	18.2	19.1	19.9	18.6	20.2	24.0			
27	19.3	20.7	17.5	19.3	19.0	18.7	20.3			
28	26.1	31.8	25.2	32.0	67.3	32.2	31.5			
29		74.3		34.9	32.6	35.0	179.1			
30	15.6	25.9	14.8	31.7	33.9	31.9	32.8			
C=O		161.2								
OCH ₃							51.8			
OCH ₃							51.8			
Ref	[62]	[92]	[93]	[94]	[95]	[95]	[96]			

Ref: References; * ¹³C-NMR data of acetylated compound; * Values bearing the same superscript are interchangeable; Solvent: CDCl₃; ^a CDCl₃ + Pyridine-d₅, ^b Pyridine-d₅; ^c DMSO-d₆; ¹³C-NMR data of some compounds were not found. In these cases, the reported identification was performed by comparison of other physical data: F5 [97], F33 [98], F46 (¹H-NMR) [99], F48 (¹H-NMR) [100], F58 (IR, MS) [101] and F78 (X-ray) [102].

Table 2. ¹³C-NMR data of quinonemethide-type pentacyclic triterpenoids isolated from Celastraceae species (2001–2021).

C	Q1	Q2	Q3	Q4	Q5	Q6 ^b	Q7	Q8	Q9	Q10
1	121.6	119.8	119.8	164.7	119.5	119.7	119.8	120.0	119.5	119.8
2	178.8	178.4	178.3	178.3	178.1	178.4	178.4	178.1	178.3	178.4
3	145.9	146.0	146.2	146.0	145.9	146.1	146.2	146.3	146.0	146.1
4	118.0	117.0	117.5	118.2	118.0	117.2	117.1	116.8	117.2	117.2
5	128.6	127.5	128.5	127.5	127.3	127.9	127.9	127.9	127.3	127.8
6	132.2	133.8	132.1	134.0	134.0	133.3	133.3	134.4	134.0	133.6
7	118.8	117.9	118.6	117.2	118.0	118.3	118.3	121.9	118.0	118.2
8	167.2	165.7	164.9	169.7	170.1	168.7	168.7	18.6	169.7	168.4
9	48.1	43.0	43.0	47.8	43.0	42.9	42.9	44.6	42.4	42.6
10	161.6	164.4	164.2	164.0	164.8	164.2	164.2	159.7	164.6	164.7
11	65.3	34.3	32.5	33.7	33.0	33.2	33.2	37.3	33.5	34.0
12	43.4	27.5	31.1	30.2	30.0	29.9	29.9	35.9	29.5	30.0
13	40.6	40.3	39.0	42.6	40.7	40.0	40.0	42.4	39.2	40.6
14	44.9	47.3	49.6	44.6	45.0	44.2	44.2	136.9	44.5	44.3
15	28.7	129.4	73.0	28.4	28.6	29.4	29.4	128.6	28.2	28.3
16	36.2	135.6	41.4	68.2	36.5 *	35.7	35.7	40.5	36.1	29.5
17	30.87	33.7	37.6	30.2	31.6	35.9	35.9	39.8	38.1	44.8
18	43.9	42.6	43.7	46.9	43.2	43.3	43.3	43.7	46.1	45.1
19	30.81	30.7	31.9	29.6	24.8 **	36.9	36.9	40.7	30.8	32.0
20	40.4	41.0	41.8	39.4	35.7	73.7	73.7	75.0	42.6	40.9
21	29.7	29.4	213.7	28.4	24.8 **	214.9	214.9	213.0	38.1	213.5
22	34.3	32.3	54.2	38.3	36.5 *	50.5	50.5	50.5	67.9	76.4
23	10.4	10.3	10.3	10.3	10.4	10.3	10.3	10.4	10.1	10.3
24										
25	34.4	37.4	41.0	38.3	38.9	38.5	38.5	29.6	38.1	39.2
26	21.4	28.8	23.6	21.7	21.6	23.3	23.3	22.1	21.6	21.6
27	18.5	18.0	23.5	19.7	21.4	19.4	19.4	23.7	19.0	20.5
28	31.4	27.4	32.9	24.2	31.4	33.2	33.2	30.4	24.0	25.0
29	178.7	178.3		178.2		29.0			178.2	
30	32.7	31.3	15.0	32.4	69.6		29.0	24.8	32.2	14.7
OCH ₃	51.8	51.6		51.8					51.6	
Ref	[103]	[104]	[104]	[105]	[106]	[107]	[108]	[104]	[109]	[63]
C	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20 ^c
1	119.4	120.6	119.7	120.0	119.6	119.4	119.9	120.0	119.4	119.8
2	178.4	178.3	181.1	178.1	178.3	178.4	178.0	178.1	178.8	178.6
3	146.0	147.0	161.9	146.3	146.0	146.0	146.2	146.2	146.1	146.3
4	117.1	127.5	140.9	116.8	117.1	117.2	116.7	116.7	118.6	117.4
5	127.5	120.4	117.2	128.1	127.4	127.4	127.5	127.7	127.6	127.6
6	133.9	135.4	131.7	134.4	133.9	134.2	134.9	134.5	137.8	134.4
7	118.2	118.3	200.4	122.1	117.9	118.2	121.6	121.5	122.2	118.3
8	169.8	165.3	41.9	158.6	170.1	170.7	159.7	159.0	160.2	170.4
9	42.9	39.3	58.4	44.2	42.9	43.3	44.5	44.5	45.5	43.0
10	164.7	172.6	146.6	159.7	165.0	164.4	159.7	159.9	163.5	165.1
11	33.6	28.7	32.1	36.0	33.9	33.1	37.5	37.4	37.3	33.6
12	29.8	29.3	30.2	31.8	29.7	29.4	35.6	34.8	35.2	29.7
13	39.4	39.9	39.6	42.1	41.3	40.0	43.1	42.4	43.3	39.5
14	45.0	43.1	29.2	135.6	44.8	44.0	135.3	136.0	135.5	45.1
15	28.6	29.5	27.9	127.9	28.4	29.7	128.3	126.6	129.8	28.7
16	36.4	32.4	35.9	45.6	36.0	36.5	37.8	37.9	39.0	36.4
17	30.8	45.3	31.0	36.3	31.6	30.2	33.7	38.9	35.6	30.9
18	43.6	44.2	44.2	47.8	44.9	43.7	43.9	38.7	43.6	44.4
19	25.5	33.8	28.8	37.8	30.4	25.2	33.9	33.9	34.2	30.9
20	46.2	31.0	40.5	41.7	147.9	33.0	42.6	47.4	48.0	40.5
21	25.1	34.5	29.8	213.8	30.5	22.5	28.6	69.2	68.0	29.9
22	34.0	36.3	36.5	49.8	36.9	35.2	36.1	79.4	39.0	34.8

Table 2. Cont.

23	10.3	10.5	10.2	10.4	10.2	10.3	10.3	10.3	10.5	10.3
24										
25	38.4	38.4	38.2	28.5	38.9	37.7	29.4	29.5	29.4	38.3
26	21.7	21.5	21.5	21.3	21.3	23.4	21.9	21.8	21.9	21.7
27	18.4	18.7	18.3	23.1	19.7	17.9	24.0	24.5	24.3	18.4
28	31.5	31.5	31.5	30.2	31.1	36.2	31.5	27.0	31.1	31.7
29	177.4	182.5	178.8			69.3	179.3	179.0	178.8	179.1
30	74.1	30.7	30.8	16.0	108.2		19.8	13.7	17.5	32.7
OCH ₃	51.9		51.4				51.8	52.7	52.3	51.7
Ref	[91]	[110]	[111]	[112]	[113]	[91]	[104]	[109]	[109]	[114]

C	Q21	Q22
1	119.8	119.8
2	178.6	178.4
3	146.3	146.0
4	117.4	117.1
5	127.8	127.7
6	134.1	133.6
7	118.3	118.1
8	170.3	168.7
9	43.2	42.7
10	165.1	164.7
11	34.0	33.8
12	30.2	29.9
13	40.7	40.6
14	45.2	44.6
15	28.9	28.5
16	37.4	35.5
17	30.6	38.2
18	44.3	43.5
19	25.0	32.0
20	31.4	41.8
21	71.2	213.6
22	44.4	52.5
23	10.4	10.2
24		
25	38.9	39.0
26	21.8	21.5
27	21.4	19.7
28	35.4	32.5
29		
30	18.6	15.1
Ref	[115]	[116]

Ref: References; ***: Values bearing the same superscript are interchangeable; Solvent: CDCl₃; ^b C₆D₆:CDCl₃; ^c CD₂Cl₂.

Table 3. ¹³C-NMR data of aromatic-type pentacyclic triterpenoids isolated from Celastraceae species (2001–2021).

C	A1	A3	A5	A6	A7	A8 ⁺	A9 ^a	A10 ^b	A11	A12 ^c
1	109.5	109.1	108.4	108.6	125.6	105.9	110.0	108.4	106.8	109.0
2	150.8	144.2	140.9	148.0	147.7	156.0	144.0	148.8	150.0	151.7
3	152.8	132.9	139.7	140.6	140.3	146.2	126.8	141.4	143.0	143.5
4	113.2	132.0	122.0	125.4	125.1	134.1	122.7	126.1	128.0	127.9
5	141.9	154.9	126.6	122.5	122.6	123.7	151.4	122.3	119.0	119.9
6	201.2	187.2	28.3	187.6	187.7	187.7	187.3	187.9	201.2	182.8
7	43.8	126.1	18.5	126.1	108.8	126.1	126.8	126.0	74.5	147.4
8	35.4	151.9	44.1	171.2	172.1	171.4	150.7	170.8	50.3	139.1

Table 3. Cont.

9	38.6	40.4	36.8	40.1	44.4	40.6	40.6	40.3	38.11	40.7
10	123.5	171.2	143.8	151.2	151.9	154.9	170.7	151.2	152.8	152.8
11	32.4	34.0	34.1	33.8	34.4	35.6	34.6	35.6	36.3	34.2
12	29.9	29.8	30.2	30.0	29.9	30.2	30.2	30.3	30.6	30.5
13	36.8	38.9	38.9	39.6	40.8	40.6	39.3	40.0	40.5	40.0
14	35.9	44.7	39.4	43.8	40.1	44.8	44.6	44.3	39.1	47.2
15	30.3	28.5	29.0	29.0	28.2	28.8	28.9	28.4	29.7	29.6
16	NR	36.4	36.5	35.5	36.8 **	37.5	36.6	32.1	36.2	37.8
17	35.7	30.8	30.3	36.2	31.6	30.8	30.6	38.4	29.8	31.1
18	40.4	44.3	44.5	43.3	44.8	42.7	44.4	43.5	44.1	45.4
19	29.5	30.5	30.6	36.8	30.5 *	27.9	31.1	34.3	29.8	31.9
20	39.1	40.3	40.6	73.8	148.2	132.4	44.4	42.0	41.0	41.7
21	29.6	29.7	30.0	215.0	30.5 *	119.9	30.1	214.7	29.9	30.9
22	28.2	34.8	36.2	50.2	36.8 **	35.2	35.1	52.7	34.0	36.2
23		14.7	11.3	13.6	13.6	14.4	14.8	13.7	14.0	14.0
24										
25	31.9	37.6	27.4	37.9	38.4	39.2	37.8	38.6	27.5	41.6
26	25.3	20.8	15.9	22.1	20.4	21.4	20.9	20.8	15.9	19.6
27	16.7	18.3	17.3	19.4	19.6	15.7	18.5	19.7	15.9	20.6
28	15.2	31.6	31.8	33.1	31.1	33.1	31.6	32.6	31.7	32.1
29	179.4	178.8	179.3	28.9	106.5	24.0	178.7		179.8	180.7
30	31.5	32.7	31.9				32.6	15.1	31.9	32.9
OCH ₃	55.7	51.5				56.0				
OCH ₃	55.1	61.1	51.5			60.7	51.5		51.4	52.2
Ref	[117]	[118]	[119]	[120]	[106]	[121]	[122]	[123]	[124]	[125]
C	A13	A14	A15	A16	A17⁺	A18	A19^d	A20	A21	A22
1	107.9	107.5	109.2	107.9	104.1	110.1	116.6	112.4	107.8	108.8
2	150.0	148.4	146.6	150.0	156.3	151.7	150.7	152.6 *	141.7	148.2
3	141.4	140.9	139.5	141.4	146.1	144.7	150.0	143.5	140.4	140.7
4	129.1	127.0	130.0	129.1	135.1	134.0	117.0	120.4	122.0	125.6
5	122.8	124.5	125.0	122.8	125.1	122.4	122.3	121.8	123.9	122.5
6	182.0	201.9	200.7	182.0	201.0	185.8	186.3	185.8	43.9	187.7
7	197.0	37.9	37.7	197.0	37.7	129.3	125.2	124.8	209.8	125.9
8	60.3	42.9	42.6	60.3	42.5	160.1	174.4	177.4 **	58.3	171.3
9	38.7	37.6	37.2	38.7	38.0	42.2	40.5	41.7	38.8	40.3
10	153.6	153.2	152.2	153.6	156.2	151.2	150.4	151.7 *	142.4	151.7
11	33.5	36.6	33.2	33.5	33.8	37.1	33.7	35.0	33.7	34.3
12	27.8	30.15	29.9	27.8	29.6	35.8	29.6	30.8	29.4	30.2
13	39.5	39.7	38.8	39.5	40.2	40.7	39.4	40.7	39.1	40.1
14	39.2	39.2	39.4	39.2	40.3	134.7	45.1	46.4	38.7	44.4
15	38.7	28.8	28.5	38.7	28.2	125.9	28.7	30.0	28.4	28.4
16	35.8	36.4	36.2	35.8	38.5	38.0	26.4	37.6	36.1	35.5
17	30.2	30.7	30.3	30.2	30.7	48.8	30.5	31.6	30.3	38.2
18	43.6	45.1	44.7	43.6	42.9	46.2	44.3	45.7	43.6	43.5
19	30.6	31.1	30.5	30.6	27.6	34.2	30.8	31.9	30.6	32.0
20	40.7	41.1	40.1	40.7	133.0	50.3	40.1	41.3	40.6	41.9
21	30.3	30.1	29.8	30.3	120.2	74.3	29.8	30.9	29.8	214.0
22	35.8	33.5	36.1	35.8	35.4	214.0	34.8	36.0	35.9	52.6
23	13.8	14.0	13.2		14.3	15.1	200.2	173.1 **	11.5	13.7
24										
25	31.5	26.0	25.6	31.5	27.0	21.6	36.3	37.4	27.9	38.5
26	14.7	15.7	15.4	14.7	15.4	21.7	20.5	21.3	15.1	20.7
27	16.9	15.7	16.9	16.9	15.4	23.9	18.7	19.4	16.8	19.7
28	31.5	32.1	31.7	31.5	33.0	22.5	31.6	32.1	31.5	32.6
29	180.0	180.1	179.1	180.0	24.0	175.2	181.2	182.5 **	179.4	
30	32.5	32.9	32.2	32.5		13.7	32.6	33.2	32.3	15.1
OCH ₃					56.0	52.7				
OCH ₃	51.8	52.2	51.4	51.8	60.6	61.7			51.6	

Table 3. Cont.

1'			126.5							170.0
2'			104.2							121.3
3'			147.4							112.2
4'			135.8							146.2
5'			147.4							150.8
6'			104.2							125.2
7'			77.2							114.2
8'			75.5							
9'			62.8							
OCH ₃			56.4							56.1
OCH ₃			51.4							
OCH ₃			20.6							
C=O			170.3							
Ref	[119]	[124]	[126]	[119]	[124]	[109]	[127]	[127]	[119]	[128]
C	A23	A24	A25^a	A26^a	A27^d	A28	A29			
1	108.3	107.7	110.7	110.6	108.5	116.5	113.8			
2	141.4	141.6	143.4	141.3	142.9	150.5	173.7			
3	139.8	139.5	145.2	143.1	141.9	149.7	155.5			
4	122.5	120.9	121.4	122.5	119.6	116.3	111.3			
5	126.3	125.7	126.7	126.0	122.8	117.1	119.4			
6	28.0	27.8	45.4	46.1	120.9	186.0	188.0			
7	18.3	126.0	119.6	120.9	137.3	122.8	124.4			
8	43.3	139.0	151.1	NR	43.3	149.1	153.4			
9	36.7	36.2	38.3	38.1	144.1	45.3	45.6			
10	143.8	140.0	142.6	145.1	128.5	125.3	152.8			
11	34.2	33.0	37.6	37.7	119.4	36.4	36.6			
12	30.0	29.4	31.4	30.6	32.6	28.6	28.6			
13	40.0	43.5	38.8	38.7	39.4	39.7	39.7			
14	39.3	58.0	44.7	44.5	40.1	40.5	40.5			
15	27.9	211.4	29.9	29.7	23.3	31.0	30.9			
16	29.6	47.5	37.6	37.4	36.7	34.8	34.8			
17	44.9	49.4	31.1	30.9	31.1	44.1	43.0			
18	45.4	44.3	45.1	44.9	46.3	44.1	44.2			
19	31.7	30.7	31.3	31.1	30.7	29.8	29.8			
20	41.3	40.0	40.8	40.6	38.3	30.7	30.5			
21	214.2	212.4	31.4	31.2	29.2	29.8	29.8			
22	77.6	77.8	35.9	35.7	37.2	33.5	34.4			
23	11.5	11.6	13.4	13.8	11.1	200.3	178.7			
24										
25	28.2	33.4	36.5	35.7	22.4	36.4	36.8			
26	15.3	25.6	22.7	22.4	19.1	20.6	20.2			
27	19.2	21.4	18.9	18.8	18.7	32.8	32.7			
28	25.2	24.6	32.0	31.9	32.7	18.3	18.3			
29			181.3	181.0	179.7	178.9	179.8			
30	14.8	14.8	33.5	33.3	30.4	31.8	31.6			
CH ₃			22.7	21.4		51.6	51.6			
CHOH			70.8	72.1						
Ref	[129]	[39]	[130]	[130]	[127]	[131]	[131]			

Ref: References; ⁺ ¹³C-NMR data of methylated compound; *,**: Values bearing the same superscript are interchangeable; NR: Not reported; Solvent: CDCl₃; ^a Pyridine-*d*₅; ^b CDCl₃+CD₃OD; ^c CD₃OD; ^d DMSO-*d*₆; ¹³C-NMR data for A2 were not found. The reported identification was performed by comparison of ¹H-NMR data from Sotanaphun [132]. ¹³C-NMR data for A4 were reported by Shirota et al. [122], but the chemical shifts were not attributed to each carbon atom.

Table 4. ^{13}C -NMR data of dimer-type pentacyclic triterpenoids isolated from Celastraceae species (2001–2021).

C	D1	D2	D3	D6	D7	D8	D9	D10	D11	D12
1	115.5	108.2	115.5	113.0	113.0	113.1	113.0	113.1	115.5	115.0
2	191.2	144.3	191.0	191.5	191.5	191.5	191.6	191.4	190.2	189.4
3	91.7	140.6	91.8	91.3	91.3	91.2	91.3	91.3	92.0	91.1
4	79.9	123.2	79.0	79.5	79.5	79.5	79.4	79.5	79.4	76.9
5	130.8	124.6	130.8	134.1	134.3	134.1	134.3	134.1	130.2	132.2
6	126.1	71.4	125.9	134.1	133.9	133.9	134.1	133.8	126.6	128.5
7	116.2	73.7	116.1	24.2	24.2	24.2	24.2	24.2	116.3	117.2
8	160.6	44.7	160.6	41.6	41.2	41.6	41.1	41.6	160.4	163.3
9	41.7	40.2	41.7	37.4	37.4	37.4	37.3	37.4	41.7	43.4
10	173.8	143.7	173.5	170.2	169.8	170.0	169.8	170.0	173.8	172.9
11	32.7	34.7	32.7	30.7	30.5	30.6	30.7	32.0	33.2	33.1
12	29.5	30.7	29.5	29.4	29.4	29.4	29.7	29.4	29.8 ¹	29.8
13	38.1	39.6	38.1	38.9	40.1 ¹	38.9	40.0 ¹	40.1	39.5 ²	39.9
14	44.5	40.00	44.5	40.1	40.2 ¹	40.1	39.9 ¹	38.9	44.3	44.0
15	28.4	31.4	28.4	28.3	27.9	28.4 ¹	27.7	28.3	28.3	28.5
16	36.5	36.1	36.4	36.0	35.3	36.0	29.3	36.0	35.4 ³	35.4
17	30.5	29.8	30.2	30.2	38.1	30.2	44.7 ²	30.1	38.3 ⁴	38.2
18	44.6	43.6	44.1	44.6	43.9	44.6	45.4	44.6	43.4	43.6
19	30.9	29.9	30.9	30.5	31.8	30.5	31.7	30.5	32.1	31.9
20	40.5	40.6	40.5	40.5	42.3	40.5	41.2	40.5	42.3	41.9
21	29.9	30.7	29.9	29.9	213.8	29.9	213.8	29.7	213.6	213.6
22	34.8	37.0	34.7	36.0	53.5	36.0	77.2	36.0	52.5	52.4
23	22.4	11.1	22.5	22.7	22.7	22.7	22.8	22.7	22.3	24.6
24										
25	34.8	28.0	34.8	22.1	22.9	22.1	23.0	22.1	35.6	39.7
26	22.5	17.6	22.5	16.0	15.7	16.0	15.8	16.0	22.3	22.4
27	18.6	18.3	18.6	16.9	18.1	16.9	18.9	16.8	20.1	19.7
28	31.6	31.9	31.7	31.7	32.7	31.7	25.1	31.7	32.8 ⁵	32.5
29	179.1 ¹	179.4	179.0 ¹	179.0		179.0		179.0		
30	32.9	31.7	31.9	32.3	15.2	32.3	14.9	32.3	15.2 ⁶	15.1
OCH ₃	51.7 ²	51.3	51.5 ²	51.7		51.7		51.7		
1'	110.4	109.5	110.4	110.5	110.6	110.4	110.6	110.4	109.6	108.8
2'	139.1	140.1	141.3	144.5	144.5	144.5	144.5	144.5	145.0	145.3
3'	136.2	138.9	137.0	138.3	138.3	138.4	138.2	138.4	137.6	137.4
4'	122.9	125.6	125.5	129.4	129.4	129.5	129.3	129.6	129.0	129.7
5'	127.9	123.6	127.2	123.3	123.3	123.4	123.7	123.4	126.0	125.3
6'	26.4	28.0	75.2	187.2	187.2	187.1	187.2	187.0	201.1	200.0
7'	18.5	18.5	21.8	126.3	126.3	126.3	126.3	126.3	37.6	37.4
8'	43.9	44.1	38.5	171.0	171.0	170.0	171.1	169.7	41.9	41.8
9'	36.8	36.9	37.6	40.1	40.1 ¹	39.9	40.1	39.7	37.1	37.0
10'	144.4	145.1	144.7	151.8	151.8	151.7	151.8	151.7	151.7	152.2
11'	33.9	34.3	33.8	34.2	34.3	34.4	34.3	34.6	32.9	33.2
12'	30.0	30.3	29.8	29.7	29.9	30.2	29.9	29.8	29.7 ¹	29.5
13'	38.9	39.0	38.9	39.0	39.0	40.2	39.0	40.1	39.4 ²	39.2
14'	39.4	39.4	39.1	44.7	44.7	44.3	44.8 ²	44.0	40.0	39.8
15'	28.9	29.1	29.0	28.5	28.6	28.3 ¹	28.6	28.2	28.0	27.7
16'	36.4	36.3	36.1	36.4	36.4	35.5	36.4	29.6	35.3 ³	29.3
17'	30.6	30.2	29.3	30.5	30.5	38.2	30.5	44.9 ¹	38.2 ⁴	45.0
18'	44.1	44.4	44.4	44.3	44.3	43.5	44.3	45.0 ¹	44.0	45.3
19'	30.4	29.5	30.5	31.0	31.0	32.0	31.1	30.1	31.8	31.7
20'	40.4	40.6	40.4	40.6	40.6	41.9	40.6	40.9	41.9	41.3
21'	30.3	30.7	30.3	29.9	29.7	213.7	29.7	213.6	214.1	214.0
22'	36.3	36.6	36.6	35.0	35.0	52.7	35.0	76.1	53.6	77.2
23'	10.9	10.9	10.6	13.4	13.4	13.4	13.4	13.4	13.0	13.3
24'										
25'	27.2	27.2	31.5	37.7	37.7	38.7	37.6	38.9	26.2	26.5

Table 4. Cont.

19'	30.9	29.4								
20'	40.5 ¹	40.6								
21'	29.8	31.6								
22'	35.0	36.6								
23'	13.4	10.8								
24'										
25'	37.6	22.3								
26'	20.9	17.2								
27'	18.4	17.3								
28'	31.6	31.8								
29'	179.0	179.6								
30'	32.8	31.6								
OCH ₃	51.7	51.4								
Ref	[136]	[134]	[75]	[138]	[138]	[138]	[138]	[138]	[138]	[138]
C	D23	D24	D25	D26	D27	D28	D30	D31	D32	D33
1	107.6	108.2	116.0	114.8	116.5	114.6	115.4	108.2	115.9	114.9
2	145.8	142.4	187.8	187.3	193.3	189.6	191.0	144.4	190.8	189.6
3	136.2	138.6	92.2	90.8	93.1	91.3	91.8	140.6	92.0	90.7
4	122.7	121.6	79.1	76.9	79.2	77.2	79.1	123.0	79.4	77.2 ¹¹
5	124.0	124.6	130.3	131.7	130.7	131.3	130.6	124.7	130.5	132.1
6	124.2	124.2	126.6	128.8	126.7	129.8	126.1	71.3	125.9	128.7
7	128.3	128.6	116.0	117.3	115.7	117.2	116.2	74.2	116.2	116.9
8	45.6	45.6	161.8	164.4	162.4	164.8	160.8	45.0	161.2	164.5
9	37.3	37.3	41.9	43.8	42.0	43.9	41.8	40.3	41.6	44.1
10	143.0	142.7	174.4	173.4	174.8	173.8	173.8	143.9	173.4	173.3
11	31.1	31.1	32.8	32.9	33.4	32.88	32.8	34.6	32.8	32.9
12	30.1	30.0	29.2	29.4	29.3	29.3	29.5	30.3	29.2	29.9 ¹
13	39.0	38.9	38.1	38.9	38.0	38.5	38.2	39.6	37.9	38.7
14	38.9	39.0	44.6	44.3	44.6	44.4	44.5	39.9	44.6	44.4
15	28.2	28.2	28.3	28.6	28.4	28.6	28.3	28.5	28.5	28.6 ²
16	36.4	36.0	36.3	36.2	36.2	36.2	36.4	36.1	36.3	36.4
17	30.4	30.4	30.5	30.4	30.4	30.4	30.4	29.9	30.5	30.6
18	44.5	44.5	44.0	44.1	44.1	44.1	44.2	43.9	44.2	44.4 ³
19	30.6	30.6	30.9	30.6	31.0	30.7	30.9	30.7	30.6	30.9 ⁴
20	40.5	40.5	40.0	40.3	39.7	40.1	40.5	40.7	40.3	40.5 ⁵
21	30.0	29.8	29.6	29.8	29.7	29.4	29.8	29.7	29.4	29.9 ⁶
22	36.0	36.4	34.6	34.8	34.3	34.4	34.8	36.9	34.7	34.8 ⁷
23	11.0	10.9	22.2	24.5	22.2	24.4	22.0	11.1	22.4	24.2
24										
25	22.3	22.2	34.8	39.2	35.2	39.1	34.8	28.2	37.5	39.3
26	16.9	16.9	22.4	22.5	18.4	18.6	22.3	17.1	22.0	22.4
27	17.5	17.4	18.8	18.5	22.2	22.2	18.7	18.4	18.9	18.3 ⁸
28	31.8	31.8	31.6	31.5	31.4	31.4	31.6	31.8	31.6	31.6 ⁹
29	179.1	179.1	184.5	184.3	182.4	183.5	178.7	179.4	184.4	178.9 ¹⁰
30	32.1	32.1	32.6	32.4	31.8	32.4	32.7	31.3	32.7	32.8
OCH ₃	51.5	51.5					51.7	51.6		51.6
1'	135.4	142.7	111.2	110.8	36.2	37.9	108.8	108.2	110.4	110.7
2'	36.5	34.5	144.4	145.0	18.7	18.8	140.8	142.1	144.7	144.2
3'	74.2	78.8	137.5	137.4	40.4	41.3	136.5	138.0	138.2	138.5
4'	89.9	86.1	127.2	128.3	33.0	33.1	121.3	121.0	129.5	128.2
5'	137.7	138.0	124.4	123.6	49.8	49.2	126.0	125.7	23.0	124.0
6'	32.1	35.0	192.0	189.9	35.7	35.9	124.0	124.4	187.5	187.8
7'	49.6	46.3	126.0	126.1	197.1	198.4	129.4	128.9	126.0	126.2
8'	29.7	30.0	171.4	171.0	126.0	125.9	45.5	45.9	171.4	171.5
9'	39.6	38.5	40.3	40.0	150.3	151.3	37.4	37.6	40.0	39.9
10'	42.6	34.7	150.1	151.1	37.7	37.7	142.8	141.9	151.9	151.1
11'	150.7	151.2	34.0	33.8	112.6	112.1	30.6	31.1	34.2	34.2
12'	108.7	108.5	29.3	29.1	147.2	147.0	30.0	30.0	29.9	29.6 ¹
13'	20.4	20.4	38.9	38.5	139.8	139.4	38.9	39.0	39.0	39.0

Table 4. Cont.

14'	17.1	19.3	44.7	44.6	114.9	115.8	39.0	39.1	44.6	44.7
15'	14.0	22.3	28.3	28.4	32.8	32.5	28.4	29.9	28.5	28.5 ²
16'			36.2	36.2	21.3	21.3	36.0	36.1	36.3	36.4
17'			30.4	30.3	23.3	23.2	30.6	30.5	30.4	30.6
18'			44.1	44.1			44.5	44.5	44.0	44.3 ³
19'			30.5	30.7			31.0	30.7	31.1	30.8 ⁴
20'			39.7	40.1			40.4	40.6	40.2	40.4 ⁵
21'			29.5	29.7			29.7	30.0	29.3	29.7 ⁶
22'			34.4	34.5			36.4	36.7	34.4	34.7 ⁷
23'			12.9	13.2			10.8	11.0	13.2	12.8
24'										
25'			36.8	37.5			22.5	22.2	34.7	38.0
26'			20.7	20.9			16.9	17.1	20.9	20.9
27'			18.6	18.8			17.4	17.6	18.8	18.2 ⁸
28'			31.3	31.5			31.8	31.8	32.5	31.6 ⁹
29'			183.6	184.3			178.7	179.5	183.6	178.7 ¹⁰
30'			32.4	32.2			32.1	32.1		32.8
OCH ₃							51.6	51.5	32.4	51.6
Ref	[138]	[138]	[139]	[139]	[139]	[139]	[133]	[134]	[139]	[136]
C	D34	D35	D36	D37	D38	D39	D40	D41	D42	D43
1	116.0	114.9	116.0	109.0	111.4	115.8	114.7	115.5	115.5	115.0
2	190.4	189.5	190.4	145.1	149.7	191.1	189.4	190.2	190.3	189.5
3	91.8	90.6	91.8	142.8	143.3	91.9	91.0	92.0	92.0	91.0
4	79.4	76.9	79.3	122.5	125.2	78.8	77.3	79.3	79.4	76.8
5	130.9	132.0	130.9	125.7	122.4	131.1	131.8	130.3	130.3	132.1
6	126.1	128.7	126.2	124.6	187.5	126.1	128.8	126.6	126.6	128.7
7	116.2	116.8	116.4	128.3	126.2	116.4	117.2	116.3	116.3	117.3
8	160.2	164.6	159.9	44.9	170.2	159.5	164.4	160.3	160.1	163.0
9	41.5	44.2	41.4	39.4	39.3	41.3	43.9	41.7	41.6	43.7 ¹
10	173.2	173.4	173.2	143.3	151.7	173.4	173.2	173.7	173.8	173.0
11	33.3	32.8	33.5	31.7	34.3	33.5	32.8	33.2	33.4	33.3
12	29.8 ¹	29.5	29.9 ¹	29.9	30.2	30.0	29.8	29.9 ¹	29.9 ¹	29.9
13	39.5	38.6	39.5	38.3	39.9	39.5	38.6	39.4	39.4	39.8
14	44.2	44.4 ¹	43.9	32.8	44.3	44.1	44.4	44.3	44.0	43.61
15	28.3	28.6	28.1	27.5	28.4	28.3	28.6	28.3	28.0	28.2
16	35.5	36.4	29.5 ²	35.3	35.6	29.7	36.4	35.4	29.5	29.5
17	38.2	30.5	44.7	35.4	38.2	39.0	30.5	38.2	44.7	45.0
18	43.4	44.1	44.9	43.5	43.5	43.8	44.2	43.4	44.9	44.8
19	32.2	30.8	32.1	31.0	32.0	32.1	30.9	32.1	32.1	31.9
20	41.9	40.4	40.8	40.1	41.9	41.8	40.5	41.9	40.8	40.9
21	213.6	29.9	213.5	214.3	213.7	213.6	29.8	213.6	213.6	213.5
22	52.5	34.7	76.5	53.9	52.6	52.5	35.0	52.5	76.5	76.4
23	22.1	24.2	22.2	10.8	13.2	22.1	24.6	22.3	22.2	24.6
24										
25	35.7	39.3	35.8	32.8	38.7	35.6	39.2	35.6	35.6	40.1
26	22.3	22.4	22.4	18.6	20.8	22.3	22.3	22.3	22.4	22.3
27	20.1	18.2	20.9	16.1	19.7	15.0	18.2	20.0	20.9	20.4
28	32.5	31.5	25.0	22.7	32.6	32.5	31.6	32.6	25.0	25.0
29		178.8					179.1			
30	15.1	32.7	14.7	15.1	15.1	20.0	32.9	15.1	14.8	14.8
OCH ₃		51.6					51.6			
1'	110.5	110.7	110.6	92.9	92.8	108.1	110.6	111.4	111.3	110.6
2'	144.4	144.3	144.4	38.4	38.8	141.6	145.2	144.6	144.6	145.1
3'	138.3	138.5	138.3	128.2	128.1	137.6	137.5	137.6	137.6	137.5
4'	129.3	128.3	129.3	140.6	140.7	122.5	128.3	127.6	127.7	128.4
5'	123.3	123.9	123.4	96.8	96.8	125.0	123.8	124.5	124.5	123.9
6'	187.2	187.6	187.2	38.2	38.4	124.0	187.4	187.9	187.8	187.3
7'	126.3	126.1	126.2	43.6	43.3	129.2	126.1	126.1	126.2	126.1

Table 4. Cont.

8'	171.0	170.4	171.1	35.7	35.4	45.5	171.2	171.7	171.6	171.7
9'	40.1	39.7	40.8	32.7	33.0	38.2	40.0	40.0	39.9	40.0
10'	151.8	151.0	151.8	42.2	39.3	143.8	151.1	150.5	150.5	151.2
11'	34.3	34.3	34.3	151.2	150.9	36.6	34.0	34.2	34.2	34.0
12'	30.0	30.2	29.8 ¹	108.6	108.8	36.4	29.8	29.9 ¹	29.9 ¹	29.9
13'	39.0	40.2	39.0	19.9	20.0	37.5	39.0	39.0	39.0	39.0
14'	44.7	44.3 ¹	44.9	19.0	19.1	38.2	44.7	44.7	44.9	44.7
15'	28.6	28.4	28.6	12.5	12.4	28.3	28.5	28.5	28.5	28.5
16'	36.4	35.5	36.4			35.4	36.4	36.4	36.4	36.4
17'	30.5	38.2	30.5			30.4	30.5	30.5	30.5	30.5
18'	44.3	43.5	44.3			44.4	44.2	44.3	44.3	44.2
19'	31.1	32.0	31.1			29.8	30.8	30.9	30.8	30.9
20'	40.6	41.9	40.7			40.6	40.4	40.4	40.4	40.5
21'	29.7 ¹	214.7	29.7 ²			29.8	29.5	29.9 ¹	29.8	29.7
22'	35.0	52.6	35.0			35.8	34.7	34.7	34.8	35.0
23'	13.3	12.8	13.3			10.8	13.2	13.0	13.0	13.2
24'										
25'	37.6	38.9	37.7			22.3	37.7	37.6	37.6	37.7
26'	20.9	20.8	20.8			17.5	20.9	20.8	20.8	20.9
27'	18.5	19.7	18.6			17.0	18.4	18.3	18.3	18.5
28'	31.6	32.6	31.6			31.8	31.5	31.6	31.6	31.6
29'	179.3		179.4			179.3	178.8	178.7	178.8	179.1
30'	32.9	15.1	33.0			31.8	32.7	32.7	32.7	32.9
OCH ₃	51.6		51.8			51.5	51.4	51.6	51.6	51.4
Ref	[136]	[136]	[137]	[128]	[128]	[128]	[140]	[136]	[137]	[137]
C	D44	D45	D46	D47	D48	D49	D50			
1	115.2	114.6	115.5	115.5	108.2	108.2	128.3			
2	190.2	189.4	190.2	189.5	144.5	144.5	183.6			
3	92.0	91.1	92.0	92.0	140.7	140.7	96.9			
4	79.4	77.2	79.4	79.4	122.8	122.9	92.3			
5	129.8	131.8	130.3	130.2	124.7	124.7	39.5			
6	126.8	128.9	126.6	126.5	71.4	71.4	28.1			
7	116.1	117.2	116.2	116.3	74.1	74.1	32.8			
8	161.5	164.4	160.4	160.5	43.6	43.6	30.4			
9	42.0	44.0	41.7	41.8	40.4 ¹	40.4 ¹	43.7			
10	174.3	173.2	173.7	173.6	143.7	143.7	140.7			
11	32.9	32.8	33.2	32.8	34.5	34.5	35.4			
12	29.5	29.6 ¹	29.8	29.5	30.2	30.2	30.6			
13	38.1	38.6	39.4	38.5	40.6 ¹	40.6 ¹	44.5			
14	44.7	44.4	44.3	44.2	40.4 ¹	40.4 ¹	40.5			
15	28.4	28.6	28.3	28.4	29.3	29.3	30.0			
16	36.3	36.4	35.4	35.5	35.5	35.5	36.4			
17	30.5	30.5	38.2	37.1	37.9	37.9	40.5			
18	44.1	44.3	43.4	43.6	43.8	43.7	43.7			
19	30.9	30.8	32.1	34.2 ¹	31.9	31.9	43.7			
20	40.4	40.4	41.9	53.6	42.2	42.2	151.2			
21	29.8	30.1 ²	213.6	209.4	214.7	214.6 ²	39.0			
22	34.7	34.7	52.5	51.9	53.9	53.9	38.2			
23	22.2	24.6	22.3	22.3	11.3	11.3	12.6			
24										
25	34.9	39.1	35.6	35.2	29.1	29.1				
26	22.5	22.4	22.3	22.8	15.7	15.7	19.1			
27	18.7	18.2	20.0	18.2	19.3	19.2	32.1			
28	31.6	31.6	32.6	32.6	33.1	33.1	20.5			
29	178.9	178.8		175.1			108.7			
30	32.7	32.8	15.1	25.1	15.2	15.2	19.9			
OCH ₃	51.6	51.6		52.6						
1'	111.4	110.5	111.4	111.4	109.7	109.7	109.2			
2'	144.7	145.2	144.7	144.6	141.5	141.4	145.0			

Table 4. Cont.

3'	137.7	137.6	137.7	137.6	140.3	140.3	142.8
4'	127.8	128.6	127.8	127.8	121.8	121.8	122.4
5'	124.5	123.9	124.5	124.5	124.3	124.3	125.7
6'	187.7	187.2	187.7	187.7	119.7	119.8	124.4
7'	126.1	126.2	126.2	126.1	138.2	138.1	128.7
8'	170.4	169.9	170.8	170.7	43.9	43.9	45.5
9'	39.7	39.7	39.8	39.8	142.8	143.0	37.3
10'	150.4	151.1	150.3	150.4	131.8	131.8	143.3
11'	34.5	34.3	34.1	34.3 ¹	122.7	122.6	31.2
12'	30.2	30.1 ²	29.9	30.1	37.5	37.4	30.0
13'	40.1	40.1	39.2	40.2	40.1	40.1	38.9
14'	44.0	43.9	44.3	44.3	40.7	40.4 ¹	38.9
15'	28.2	28.2	28.6	28.4	24.0	23.6	28.1
16'	29.6	29.5 ¹	35.7	35.5	35.9	29.5	36.4
17'	44.9	44.9	37.1	38.2	39.2	45.3	30.4
18'	45.0	45.0	43.9	43.5	45.7	46.7	44.5
19'	32.0	31.9	34.2	32.0	32.5	32.1	30.6
20'	40.9	40.9	53.6	41.9	42.4	41.3	40.5
21'	213.7	213.6	209.4	213.7	214.9	214.5 ²	30.0
22'	76.5	76.7	51.9	52.6	51.2	75.4	36.0
23'	13.0	13.2	13.0	13.0	10.7	10.7	10.8
24'							
25'	38.7	38.9	38.2	38.4	22.4	22.4	22.1
26'	20.9	20.9	21.2	20.8	19.6	19.8	16.9
27'	20.6	20.7	17.8	19.7	20.6	21.4	17.4
28'	25.0	25.0	32.6	32.6	31.5	24.2	31.8
29'			175.0				179.2
30'	14.8	14.7	25.1	15.1	15.4	15.0	32.1
OCH ₃			52.5				51.6
Ref	[137]	[137]	[137]	[137]	[141]	[141]	[142]

Ref: References; ^{1,2,3,4,5,6,7,8,9,10}: Values bearing the same superscript are interchangeable; ¹¹: Signal bearing this superscript was superimposed on solvent signals; Solvent: CDCl₃; ¹³C-NMR data for D4, D5 and D29 were reported by Gonzalez et al. [143] but the chemical shifts were not attributed to each carbon atom.

Table 5. ¹³C-NMR data of lupane-type pentacyclic triterpenoids isolated from Celastraceae species (2001–2021).

C	L1 ⁺	L2	L3	L4	L5	L6	L7	L8	L9	L10
1	38.4	38.7	41.8	123.6	42.1	39.6	39.6	79.5	39.8	39.3
2	23.7	27.4	34.0	165.1	34.2	34.1	34.1	42.9	34.3	34.3
3	80.9	79.0	218.3	205.3	218.8	218.0	217.7	216.1	218.2	221.4
4	37.9	38.9	47.5	45.0	47.6	47.3	47.2	47.1	47.5	50.7
5	55.4	55.2	54.6	52.9	54.8	54.9	54.9	51.2	55.1	55.3
6	18.2	18.3	19.4	18.9	19.6	19.6	19.6	19.6	19.8	19.2
7	34.3	34.3	33.9	34.5	34.3	33.5	33.6	32.9	33.7	33.6
8	40.9	40.8	42.2	42.9	42.4	40.8	40.6	41.0	41.0	40.7
9	49.9	50.0	54.5	48.9	54.9	49.3	49.8	50.6	50.0	49.5
10	37.1	37.1	38.0	40.6	38.2	36.8	36.9	45.1	37.0	36.6
11	20.9	20.8	70.1	70.6	70.5	21.4	21.5	22.9	21.6	21.7
12	27.6 [*]	26.5	37.2	37.3	37.4	24.8	25.1	25.1	25.0	25.2
13	37.9	37.8	36.1	37.1	37.2	37.4	37.7	37.9	37.8	37.5
14	43.1	42.9	42.2	42.8	42.6	44.1	41.9	42.9	42.8	42.8
15	27.2	27.2	26.8	27.3	27.4	36.8	26.9	27.5	27.3	27.0
16	35.3	35.3	33.6	35.3	35.4	76.9	33.1	35.5	35.9	34.0
17	43.0	43.1	47.3	43.0	43.0	48.6	80.2	42.9	42.0	47.8
18	49.0	47.1	47.8	47.5	47.6	47.6	48.3	47.9 [*]	48.2	48.6
19	42.8	37.4	47.4	47.7	47.7	47.5	48.0	48.2 [*]	60.0	47.8
20	49.0	49.7	149.5	150.2	150.2	149.9	149.6	150.7	148.4	150.3

Table 5. Cont.

21	25.2 *	23.6	29.4	29.7	29.8	29.8	29.4	29.8	77.9	29.7
22	40.0	40.5	28.8	39.8	39.8	37.7	38.5	40.0	49.6	29.1
23	28.0	28.0	27.2	21.4	27.5	26.6	26.6	28.0	26.8	22.1
24	16.6	15.4	20.5	28.2	20.8	21.0	21.0	19.8	21.2	65.3
25	16.1 **	16.0	16.5	19.9	16.7	16.0	16.0	11.9	16.1	17.0
26	16.0 **	15.9	16.6	17.4	16.9	15.8	15.9	15.9	16.0	15.6
27	14.4	14.3	14.4	14.4	14.4	16.1	13.8	14.4	14.6	14.7
28	18.0	17.9	60.3	18.0	18.1	11.7		18.1	19.8	60.5
29	207.0	7.3	110.1	113.5	109.9	109.8	109.6	109.5	111.5	109.8
30	14.5	205.1	18.9	19.3	19.4	19.3	19.3	19.3	19.9	19.1
COOCH ₃	21.3									
COOCH ₃	171.0									
Ref	[144]	[145]	[146]	[147]	[148]	[149]	[145]	[150]	[14]	[151]
C	L11	L12	L13	L14	L15	L16	L17^a	L18	L20	L21
1	39.6	39.6	125.2	39.8	40.2	39.7	34.1	42.4	39.7	53.5
2	34.1	34.1	159.2	34.0	35.7	34.3	26.6	34.3	34.2	211.4
3	218.2	218.0	205.0	218.0	216.5	218.3	75.1	218.6	217.9	82.5
4	47.3	47.4	44.6	47.3	47.7	47.5	38.1	47.6	47.4	45.6
5	54.9	55.0	53.5	54.8	55.4	55.1	49.2	54.9	55.1	54.6
6	19.6	19.6	19.0	19.0	20.4	19.8	18.5	19.5	19.7	18.5
7	33.5	33.5	33.7	33.5	34.2	33.8	34.5	34.2	33.7	34.0
8	40.9	42.7	41.8	40.9	41.5	41.0	41.1	42.1	40.8	41.3
9	49.7	49.6	44.5	49.7	49.8	50.0	50.8	54.7	49.7	50.4
10	36.8	36.9	39.5	36.8	37.7	37.0	37.7	38.2	36.9	43.9
11	21.4	21.4	21.2	21.3	22.2	21.7	20.8	70.1	21.5	21.0
12	26.8	27.6	25.2	25.2	28.2	26.8	26.1	37.6	27.6	25.1
13	37.3	37.1	37.5	37.4	38.0	38.3	35.2	37.6	37.9	37.2
14	42.7	40.8	43.0	42.8	43.5	43.0	41.4	42.3	42.8	42.8
15	27.0	26.9	27.0	27.0	28.2	27.6	28.2	28.8	27.4	27.1
16	33.8	29.1	29.1	29.1	34.5	35.6	22.9	28.9	35.4	29.3
17	47.8	48.0	47.7	47.7	37.6	43.2	54.0	59.3	43.3	47.8
18	49.3	52.3	48.6	48.6	50.4	49.0	55.5	59.3	47.7	48.7
19	43.5	36.5	47.8	47.3	52.8	43.9	92.2	47.2	47.7	47.8
20	154.4	157.0	150.3	150.0	211.5	154.9	141.4	149.1	157.2	150.2
21	29.1	32.8	29.7	29.7	27.8	31.9	34.4	29.8	32.7	29.7
22	31.7	33.9	33.9	33.9	40.4	40.0	29.3	32.9	40.0	33.8
23	26.7	26.6	21.4	26.6	27.1	26.8	29.2	20.7	26.6	29.1
24	21.1	21.1	27.8	21.0	21.3	21.2	22.8	27.4	21.1	16.4
25	16.0	15.9	19.2	15.8	16.1	16.1	16.5	16.8	15.9	17.0
26	15.8	15.8	16.5	15.9	14.8	16.0	15.7	16.7	15.8	14.8
27	14.7	14.6	14.6	14.7	16.4	14.6	13.6	14.1	14.4	15.6
28	60.2	60.2	60.6	60.5	18.3	17.9	178.6	206.0	17.8	60.5
29	107.2	133.2	109.9	109.7		106.9	112.3	110.7	133.0	109.9
30	65.0	194.9	19.0	19.6	29.3	65.2	19.3	19.0	195.0	19.1
Ref	[152]	[153]	[151]	[149]	[14]	[14]	[153]	[151]	[148]	[73]
C	L22	L23^b	L24	L25	L26	L28	L29	L30	L31	L32
1	34.0	35.4	33.6	53.4	38.6	38.6	26.3	38.6	53.5	38.7
2	22.9	23.7	25.9 *	211.5	24.0	27.4	23.1	27.3	211.4	26.9
3	78.2	80.3	76.4	82.9	81.0	78.9	76.0	78.8	82.9	78.9
4	36.7	37.7	37.5	45.6	38.3	38.9	36.4	38.8	45.6	38.8
5	50.3	51.6	49.9 **	54.6	55.6	55.3	52.4	55.1	54.6	55.3
6	18.0	19.2	18.4	18.5	18.4	18.3	20.9	18.2	18.5	18.2
7	34.4	35.3	34.4	33.8	34.2	34.3	33.0	34.1	33.8	34.3
8	40.9	42.2	41.0	41.2	41.2	40.6	43.1	40.7	43.9	40.8
9	50.7	51.5	50.5 **	50.4	50.5	50.4	45.7	50.2	50.4	50.4
10	37.2	38.3	37.3	44.0	37.3	37.2	39.8	37.1	41.3	37.1
11	20.8	21.9	20.8	21.1	21.1	21.0	23.6	20.8	21.0	20.8
12	27.2	28.8	25.6 *	24.8	25.4	27.3	25.8	27.2	25.0	27.4

Table 5. Cont.

13	39.8	39.2	38.7	37.9	37.3	36.6	38.3	36.2	37.2	38.5
14	44.0	43.9	42.6	42.9	42.9	41.8	40.3	42.5	42.8	42.5
15	28.1	28.5	29.5	29.4	27.3	26.8	27.8	26.9	27.0	29.2
16	32.1	36.4	28.8	35.4	29.3	32.8	35.6	28.8	29.1	31.7
17	54.3	44.3	59.3	42.9	48.0	80.3	43.0	47.8	47.7	59.3
18	143.8	52.0	48.0 ***	48.2	49.0	49.2	48.3	49.6	48.6	48.6
19	139.2	38.3	47.5 ***	47.29	48.0	52.2	47.9	52.0	47.7	43.2
20	207.2	158.3	149.8	150.7	150.7	212.2	150.9	213.5	48.6	154.1
21	34.8	33.4	30.0	29.8	30.0	27.5	29.9	27.6	29.7	28.9
22	35.1	40.9	33.2	29.9	34.4	38.7	40.0	33.9	33.9	32.9
23	27.7	28.3	28.2	29.2	28.2	28.0	29.6	27.9	29.3	28.0
24	21.7	22.2	22.2	16.4	16.9	15.4	24.0	15.4	16.3	15.3
25	16.5	16.5	15.9 ****	17.0	16.4	16.2	101.4	16.0	17.0	15.9
26	16.1	16.7	16.1 ****	15.6	16.2	16.0	16.2	15.9	15.6	16.1
27	15.7	15.1	14.2	14.5	15.0	13.2	14.7	14.6	14.7	14.3
28	66.0	18.3	205.6	18.0	60.8		18.0	60.5	60.5	206.3
29		134.8	110.1	109.5	109.9		109.3		109.9	107.4
30	30.7	197.3	19.0	19.3	19.3	29.9	19.3	29.4	19.1	65.0
OCH ₃	21.4	21.3					54.6			
C=O	170.8	173.4			167.7					
1'					126.7					
2'					130.1					
3'					115.8					
4'					159.3					
5'					130.1					
6'					130.1					
7'					116.3					
8'					144.5					
Ref	[154]	[154]	[155]	[73]	[156]	[145]	[54]	[157]	[158]	[145]
C	L33 ^a	L35 ^c	L36	L37	L38	L39	L40	L41	L42	L43
1	39.3	38.4	78.7	38.4	38.4	38.6	38.6	53.5	38.7	38.7
2	28.3	23.8	4.2	23.9	23.8	27.3	27.4	211.5	27.3	27.4
3	78.0	81.3	77.6	55.4	80.6	78.9	78.9	82.9	78.9	79.0
4	39.3	38.1	NR	38.1	37.9	38.8	38.8	45.6	38.8	38.9
5	53.2	55.4	53.1	55.4	55.4	55.2	55.2	54.6	55.5	55.3
6	30.3	18.2	17.8	18.2	18.2	18.2	18.3	18.5	18.2	18.3
7	74.4	34.1	34.0	34.2	34.3	34.2	34.2	33.8	34.3	34.3
8	47.2	41.9	41.4	40.9	40.9	40.7	40.7	41.2	40.8	40.8
9	51.1	50.3	51.4	50.3	50.4	50.3	50.2	50.4	50.4	50.2
10	37.6	37.1	43.5	37.1	37.1	37.1	37.2	44.0	37.1	37.1
11	21.3	21.8	23.8	21.0	21.0	20.7	20.9	21.1	20.7	20.9
12	26.3	25.1	25.0	25.1	25.1	27.5	27.3	24.9	25.5	27.6 ^A
13	39.3	37.3	38.1	38.1	38.1	37.2	37.0	37.9	38.7	37.7
14	44.0	42.7	37.6	43.0 *	42.9	42.3	42.7	42.9	42.5	42.7
15	34.0	27.0	27.5	27.4	27.5	29.0	27.4	27.4	29.2 *	27.3
16	32.8	29.2	35.6	35.6	35.6	28.7	35.0	35.5	28.8 *	35.4
17	26.7	48.2	42.9	42.8 *	43.0	59.3	43.0	43.0	59.3	43.3
18	49.7	48.8	48.3	48.3	48.3	48.0	49.7	48.2	48.0 **	51.2 ^B
19	47.7	47.7	48.0	47.7	48.0	51.1	52.6	47.9	47.5 **	36.7 ^C
20	151.1	150.4	150.8	151.0	151.0	211.8	212.9	150.8	149.7	157.0 ^B
21	30.9	29.7	29.8	29.9	29.9	27.6	27.6	29.8	29.8	32.6 ^B
22	37.2	34.0	40.0	40.0	40.0	32.4	39.8	39.9	33.2	39.9
23	28.5	28.0	27.8	28.0	28.0	28.0	28.0	29.3	27.9	28.0
24	16.4	16.7	16.2	16.7	16.6	15.4	15.4	16.4	15.4	15.4
25	16.3	16.2	12.0	16.2 **	16.2	16.1	16.1	17.0	15.9 ***	16.1
26	10.9	16.0	16.2	16.0 **	16.0	15.8	15.9	15.6	16.1 ***	15.9
27	15.1	14.8	14.4	14.5	14.5	14.2	14.5	14.5	14.2	14.4
28	176.6	60.6	17.9	18.0	18.0	206.1	18.0	18.0	205.6	17.8
29	110.0	109.8	109.4	109.4	109.4	30.2	29.2	109.5	110.1	132.9 ^B

Table 5. Cont.

30	19.5	19.1	19.2	19.3	19.3			19.3	19.0	195.1
1'		127.3	167.6	127.1	173.7					
2'		115.3	115.7	115.1	34.9					
3'		144.2	145.1	144.9	25.2					
4'		146.8	127.4	147.3	29.2					
5'		114.2	114.4	113.9	29.3					
6'		122.3	144.0	122.0	29.4					
7'		144.9	146.6	144.9	29.6					
8'		115.8	115.5	115.7	29.7					
9'–14'		168.0	122.4	167.7	29.7					
15'					29.5					
16'					31.9					
17'					22.7					
18'					14.1					
Ref	[153]	[159]	[160]	[159]	[161]	[145]	[145]	[162]	[155]	[163]
C	L44	L45	L46	L47	L48	L49	L50^a	L51	L52	L53
1	42.5	42.5	42.1	42.1	38.4	40.9	42.6	38.4	40.1	39.8
2	34.4	34.4	34.4	34.5	27.7	178.5	174.4	36.2	34.5	34.3
3	216.8	216.8	216.7	216.8	81.0	187.5	182.4	217.2	216.3	218.3
4	48.9	48.9	48.9	49.0	37.8	45.6	46.9	47.0	42.2	47.0
5	56.6	56.6	56.5	56.6	55.4	48.2	48.4	49.6	56.5	55.1
6	69.7	69.7	69.6	69.7	18.2	21.3	21.6	19.9	69.8	19.8
7	42.1	42.1	42.2	42.2	34.2	33.7	33.8	33.5	41.9	37.2
8	40.7	40.7	40.0	40.0	40.9	41.8	41.1	40.8	37.5	40.8
9	50.6	50.6	50.6	50.5	50.4	41.7	42.0	52.4	50.9 *	50.0
10	36.8	36.8	36.7	36.7	37.1	40.7	42.3	36.6	34.5	37.1
11	21.8	21.8	21.3	21.3	21.0	19.2	22.2	21.7	21.3	21.5
12	28.7	28.7	26.7	29.7	25.1	24.9	27.3	26.0	25.2	25.7
13	36.8	36.8	37.1	36.8	38.1	37.9	38.6	38.6	37.5	38.6
14	43.9	43.9	42.9	43.2	42.8	43.2	43.5	42.7	42.9	42.6
15	27.7	27.7	27.4	27.4	27.5	27.5	27.9	31.1	29.9	29.8
16	35.6	35.6	35.3	35.3	35.6	35.5	35.6	32.6	32.2	32.2
17	44.6	44.6	43.1	43.0	43.0	43.2	43.2	56.4	56.9	56.5
18	48.5	48.5	48.9	50.6	48.3	48.4	48.9	47.5	49.5 *	49.3
19	50.1	50.1	43.7	42.1	48.0	48.0	43.8	49.6	47.0	47.5
20	73.4	73.4	154.6	157.2	151.0	150.9	156.5	151.1	150.3	150.5
21	29.1	29.1	31.7	32.7	30.0	29.8	32.2	30.0	30.7	30.7
22	40.2	40.2	39.8	39.8	40.0	39.9	40.0	37.3	37.0	33.8
23	24.9	24.9	25.0	25.0	27.1	29.8	27.8	68.0	25.7	26.8
24	23.7	23.7	23.7	23.7	16.2	21.3	24.8	17.2	21.3	21.2
25	17.5	17.5	17.0	16.9	16.5	20.8	20.4	16.0	17.3 **	16.1
26	17.0	17.0	17.1	17.1	16.0	15.9	16.3	15.9	17.1 **	16.0
27	15.2	15.2	14.8	14.7	14.5	14.6	15.0	14.6	15.0	14.8
28	19.2	19.2	17.7	17.8	18.0	18.0	17.9	178.6	181.9	181.2
29	31.7	31.7	106.9	133.2	109.4	109.4	105.9	109.6	109.8	109.9
30	25.2	25.2	65.0	195.1	19.3	19.2	64.3	19.3	19.5	19.5
C=O					171.0					
OCH ₃					21.3					
Ref	[164]	[164]	[146]	[146]	[165]	[73]	[153]	[166]	[167]	[14]
C	L54	L55	L56	L57^a	L58^d	L59^a	L61	L62	L63	L64
1	39.6	33.9	34.0	34.0	34.0	38.7	159.9	38.7	75.9	75.9
2	34.1	28.1	26.2	26.7	25.1	28.4	125.1	27.4	36.4	36.4
3	218.2	179.1	75.0	75.3	76.9	78.2	205.6	79.0	76.6	76.9
4	47.3	147.5	38.1	38.2	38.5	39.4	44.6	38.8	37.4	37.5
5	54.9	50.4	46.4	49.3	54.9	56.0	53.4	55.3	47.8	47.9
6	19.6	24.5	26.1	18.7	18.0	18.9	19.0	18.3	18.4	18.5
7	33.6	32.8	76.7	34.7	33.9	34.9	33.7	34.3	34.0	34.1
8	40.7	40.9	46.3	41.2	41.2	41.2	41.7	40.8	42.9	41.7
9	49.6	40.4	51.2	50.5	49.9	51.0	44.4	50.4	51.2	51.3

Table 5. Cont.

10	36.8	39.2	37.8	37.7	36.7	37.6	39.5	37.1	37.4	43.7
11	21.5	21.4	20.8	21.2	20.5	21.3	21.2	21.0	23.7	23.9
12	29.7	25.4	26.5	28.2	27.1	26.2	25.1	26.7	25.2	25.2
13	37.8	38.3	39.1	38.2	37.6	39.6	38.2	38.0	36.9	37.7
14	42.8	42.8	44.4	43.1	42.6	42.9	43.0	43.0	41.7	42.9 *
15	27.3	30.6	33.0	27.8	31.7	31.3	27.4	27.4	27.1	27.5
16	35.4	32.1	33.4	35.9	36.4	33.0	35.5	35.5	29.2	35.7
17	43.1	56.5	56.3	43.5	55.5	56.7	43.1	42.8	43.6	43.0 *
18	50.9	49.4	49.6	51.3	46.7	47.9	48.1	48.9	48.8	48.1 **
19	40.7	46.9	48.0	41.4	48.7	49.9	47.3	43.8	47.8	48.4 **
20	146.3	150.4	151.4	149.2	150.4	151.4	150.8	154.8	150.3	150.8
21	32.9	29.7	31.2	33.5	30.1	30.4	29.8	31.8	29.7	29.8
22	39.7	36.9	37.7	40.2	38.3	37.7	40.0	39.8	34.0	40.0
23	26.6	113.4	29.0	29.4	28.1	28.8	27.8	28.0	27.7	27.6
24	21.0	23.2	22.4	22.7	15.8	16.4	21.4	16.1	21.9	22.0
25	15.9	20.1	16.1	16.3	15.9	16.5	19.2	16.0	11.7	11.5
26	15.8	15.9	12.1	16.4	16.0	16.5	16.4	15.4	16.2	16.1
27	14.4	14.6	15.1	14.8	14.4	15.0	14.4	14.5	14.8	14.6
28	17.9	176.6	179.0	18.2	177.3	178.9	18.0	17.7	60.6	18.1
29	124.9	109.7	109.9	122.4	109.6	110.0	109.5	107.6	109.8	109.5
30	171.2	19.3	19.5	170.3	19.0	19.6	19.3	65.0	19.0	19.3
OCH ₃		51.3			51.3					
1'			166.3							
2'			117.6							
3'			156.4							
4'			27.0							
5'			20.2							
Ref	[146]	[118]	[153]	[154]	[168]	[169]	[170]	[145]	[146]	[150]
C	L65	L66	L67	L68	L69	L70	L71	L72	L73	L74
1	79.0	44.5	39.5	39.6	35.5	35.4	33.5	32.5	39.0	38.9
2	37.5	71.3	34.1	34.2	25.6	25.6	28.2	25.3	27.5	27.4
3	75.7	78.5	217.8	218.1	75.9	75.9	76.0	76.4	78.6	78.9
4	38.9	38.2	47.3	47.3	37.8	37.8	38.8	37.6	39.4	38.8
5	53.1	55.2	54.9	54.9	48.9	48.9	48.5	48.2	55.6	54.9
6	18.0	18.1	19.6	19.7	18.0	18.3	21.1	18.4	18.1	18.5
7	34.1	34.2	33.2	33.6	35.1	35.1	34.2	34.4	35.3	37.8
8	41.3	40.9	40.9	40.8	42.6	42.7	40.9	41.1	41.1	42.5
9	51.4	50.9	49.6	49.8	55.6	55.6	50.4	50.5	55.7	51.0
10	43.5	36.9	36.8	36.9	39.1	39.1	37.3	37.3	37.7	37.4
11	23.8	21.1	21.2	21.5	70.5	70.6	20.8	21.2	70.5	21.0
12	25.0	25.2	25.3	25.2	37.6	37.6	25.2	25.3	27.7	25.2
13	38.0	38.0	37.3	38.2	36.3	37.1	37.1	38.0	37.7	37.6
14	42.8	42.9	42.7	42.9	42.9	42.7	42.7	43.0	42.6	47.9
15	27.4	27.3	26.9	27.4	27.0	27.3	27.1	27.6	27.5	69.7
16	35.5	35.6	34.8	35.5	33.8	35.4	29.2	35.8	35.5	46.5
17	42.9	43.0	37.8	43.0	47.8	43.0	48.1	43.2	43.0	43.0
18	48.3	48.3	47.0	48.3	48.2	47.7	47.8	48.2	47.7	48.1
19	47.9	48.0	59.0	48.0	47.6	47.7	48.0	48.2	47.4	47.4
20	150.8	151.0	143.4	150.6	149.8	150.2	150.4	151.2	150.2	150.4
21	29.7	29.9	217.7	29.9	29.1	29.8	29.8	29.9	29.9	30.1
22	39.9	40.0	55.4	40.0	29.3	39.8	34.0	40.2	39.9	39.7
23	27.8	29.6	26.6	26.7	22.3	22.3	28.1	28.2	28.3	27.9
24	14.9	17.1	21.0	21.0	28.7	28.7	16.0	22.4	15.6	15.4
25	11.9	17.1	15.9	16.0	16.3	16.2	16.1	16.4	16.1	16.1
26	16.2	16.0	15.7	15.8	17.2	17.2	16.1	16.2	17.3	16.6
27	14.4	14.5	14.5	14.5	14.1	14.6	14.8	14.7	14.5	8.0
28	18.0	18.0	18.7	18.0	60.2	18.0	60.1	18.2	18.1	19.2
29	109.4	109.3	115.0	109.4	110.2	109.8	109.6	109.6	109.8	109.7
30	19.2	19.3	20.8	19.3	19.1	19.3	18.9	19.5	19.4	19.4

Table 5. Cont.

26	16.9	15.7
27	15.1	14.1
28	60.4	19.3
29	109.7	124.7
30	19.1	171.2
Ref	[151]	[181]

Ref: References; ⁺ ¹³C-NMR data of acetylated compound, *, **, ***, **** Values bearing the same superscript are interchangeable; NR: Not reported; Solvent: CDCl₃; ^a Pyridine-d₅; ^b CD₃COOD; ^c CD₃OD; ^d DMSO-d₆; ^A Slightly broadened peak, measured at 25 °C; ^B Broad peak, measured at 35 °C; ^C Very broad peak, determined from HSQC and HMBC spectra at 35 °C. ¹³C-NMR data for L19, L27 [159], L34, L60, L87 [182,183], L88 [182,183] and L89 were not found. These compounds were identified on the references cited here by comparison of spectroscopic data with those reported in the literature, but we could not get access to the original papers.

Table 6. ¹³C-NMR data of oleanane-type pentacyclic triterpenoids isolated from Celastraceae species (2001–2021).

C	O1	O2	O3	O4	O5	O6	O7	O8	O9 ^a	O10 ^a
1	38.7	32.8	41.1	40.3	33.8	39.3	40.3	40.3	39.0	72.3
2	33.8	26.6	32.8	34.4	25.5	27.3	34.4	34.2	34.2	35.5
3	216.2	75.9	217.4	218.0	76.1	78.6	218.2	217.8	215.9	72.3
4	47.5	37.4	47.7	47.7	37.5	39.0	47.8	47.7	47.6	40.1
5	54.7	48.2	54.9	55.5	48.8	55.0	55.4	55.3	54.5	47.8
6	18.7	17.5	19.7	19.8	18.3	18.2	19.8	19.7	19.2	17.8
7	30.5	31.1	32.8	33.9	33.2	33.1	32.7	32.6	30.9	32.8
8	40.6	40.7	41.9	42.9	43.3	43.0	43.2	43.2	41.7	45.2
9	50.1	50.4	55.5	50.4	51.2	51.6	48.7	48.5	52.8	53.8
10	36.2	36.6	37.6	37.7	38.3	38.1	37.6	37.5	36.3	42.1
11	52.5	57.0	67.9	76.3	75.9	75.8	81.7	82.0	132.3	200.9
12	57.0	52.9	125.5	121.6	122.5	121.5	122.3	121.2	131.3	128.6
13	87.3	87.9	149.0	149.3	148.3	149.7	150.8	152.8	84.9	169.7
14	41.2	41.3	43.2	42.0	41.8	41.7	42.0	42.3	44.2	44.0
15	26.7	26.7	26.4	26.2	26.1	26.1	26.3	27.9	25.7	26.7
16	21.2	21.6	26.0	26.8	28.1	26.6	28.1	26.6	26.0	26.5
17	43.8	43.7	32.3	32.4	34.8	32.3	34.9	33.1	41.9	32.5
18	49.6	49.1	46.7	47.2	46.3	46.8	46.5	47.0	51.1	47.6
19	37.8	32.5	46.3	46.4	46.7	46.3	46.9	46.7	32.4	45.2
20	31.5	36.8	31.0	31.1	36.3	31.1	36.5	31.1	36.7	31.0
21	34.3	29.7	34.6	34.7	73.9	34.5	74.0	34.6	30.9	34.5
22	27.0	27.7	36.8	36.9	45.2	36.8	45.2	36.9	30.6	36.7
23	25.9	28.0	26.7	26.7	28.6	28.0	26.7	26.9	26.2	28.8
24	21.1	21.8	21.5	21.5	22.4	15.4	21.6	21.5	21.0	16.2
25	16.4	17.0	16.2	16.4	16.7	18.0	16.4	18.0	17.3	18.0
26	18.7	20.1	17.9	18.1	18.2	16.8	18.2	16.2	19.4	19.1
27	19.8	18.1	26.1	25.2	25.2	25.1	24.7	24.7	19.6	23.6
28	179.2	179.1	28.4	28.5	28.4	28.3	28.5	28.5	77.1	28.8
29	33.2	26.6	33.0	33.2	28.9	33.1	29.1	33.2	28.9	33.0
30	23.6	65.7	23.6	23.6	16.9	23.5	17.0	23.6	65.0	23.5
OCH ₃				53.7	53.7	53.7				
Ref	[184]	[185]	[186]	[104]	[187]	[188]	[187]	[187]	[189]	[190]
C	O11	O12	O13	O14	O15	O16	O17	O18 ^b	O19 ^a	O20
1	39.6	39.4	39.3	40.0	38.1	39.8	48.6	47.6	47.7	46.6
2	33.8	34.2	34.2	34.5	24.0	34.0	69.1	69.6	68.7	69.0
3	218.1	217.7	217.8	217.5	80.3	218.3	83.1	85.9	85.7	84.0
4	47.0	47.5	47.5	48.1	37.5	47.2	39.3	44.3	43.9	39.3
5	54.6	55.4	55.3	55.7	55.0	54.8	55.5	57.3	56.5	55.4
6	19.4	19.7	19.6	19.1	18.8	19.6	17.7	19.8	19.2	18.4
7	33.7	32.2	32.1	32.3	32.2	33.7	34.0	34.3	33.5	33.1

Table 6. Cont.

8	40.6	39.9	39.7	45.2	39.6	40.6	43.5	40.9	40.0	39.4
9	50.1	46.9	46.8	61.3	47.2	50.4	56.8	49.2	48.3	47.6
10	36.7	36.7	36.7	37.0	38.0	36.8	40.1	39.2	38.3	38.3
11	21.3	23.8	23.7	199.3	23.3	21.5	72.3	25.1	24.2	23.6
12	25.7	123.6	122.4	128.2	123.1	26.0	211.1	124.6	122.4	124.5
13	37.6	142.5	143.8	168.9	142.6	38.9	82.4	144.4	144.4	140.5
14	43.6	41.9	41.8	43.8	41.8	43.2	45.3	42.5	42.1	42.6
15	27.3	25.6	26.0	26.1	25.2	27.3	22.6	30.3	29.1	24.4
16	36.3	23.6	28.2	30.9	18.0	36.8	30.5	27.9	23.1	25.3
17	36.9	39.6	35.0	37.3	31.7	34.5	33.6	47.0	47.0	35.3
18	142.9	48.0	46.7	43.0	46.1	147.5	49.0	45.0	41.8	43.5
19	127.7	41.4	47.0	45.5	40.0	124.7	38.5	82.3	46.2	33.9
20	40.0	151.6	36.3	31.3	42.6	28.0	31.4	35.9	30.8	39.6
21	73.1	69.1	74.0	34.1	36.6	27.9	34.1	29.4	34.0	39.9
22	43.5	45.9	45.3	21.8	75.2	37.3	39.0	33.1	32.2	83.2
23	26.6	26.6	26.5	21.7	23.8	26.8	28.7	23.8	24.2	28.7
24	20.7	21.6	21.5	26.7	16.5	20.9	16.6	66.1	65.7	16.9
25	16.3	15.3	15.2	16.0	15.3	16.5	17.2	17.5	17.3	17.0
26	15.7	16.8	16.7	18.7	16.5	15.9	20.7	17.7	17.4	17.1
27	13.9	25.8	25.8	23.7	25.9	14.5	18.5	25.1	26.1	24.1
28	26.7	68.8	28.3	69.6	24.9	25.5	31.3	178.6	176.6	25.0
29	28.5		29.1	23.6	177.9	70.5	25.1	28.6	33.2	182.5
30	21.4	103.6	16.9	33.2	20.3	25.6	31.9	25.2	23.8	21.1
OCH ₃					51.7					
1'					173.5			93.9	93.7	
2'					34.6			78.6	78.6	
3'					23.3			78.0	79.0	
4'–11'					28.9– 29.4			70.8	70.6	
5'								78.8	79.2	
6'								62.2	62.0	
1''								103.4	104.6	
2''								75.7	76.0	
3''								77.8	78.4	
4''								72.5	72.7	
5''								77.9	78.4	
6''								63.7	63.8	
12'					31.7					
13'					NR					
14'					13.9					
Ref	[191]	[61]	[96]	[192]	[68]	[191]	[193]	[194]	[194]	[61]
C	O21	O22^a	O23	O24	O25	O26	O27	O28^a	O29	O30
1	79.6	40.0	39.5	34.7	33.4	34.1	39.1	212.9	40.3	38.7
2	44.5	34.4	34.3	29.4	25.4	22.7	27.3	45.4	23.9	23.8
3	172.4	215.9	218.1	98.0	75.8	78.0	78.7	79.0	80.2	81.2
4	56.0	47.8	47.6	40.0	37.5	36.7	39.2	40.1	38.3	37.1
5	85.0	55.1	55.3	50.2	48.4	49.7	55.0	54.9	55.2	56.0
6	33.2	19.0	19.9	19.4	17.4	17.7	17.5	18.1	17.7	18.2
7	27.6	32.1	32.8	30.8	32.6	32.5	32.9	34.4	34.0	35.1
8	43.2	45.3	40.0	38.5	43.5	43.5	46.3	40.7	44.1	40.3
9	55.2	61.2	46.9	41.6	61.6	61.6	60.4	42.8	54.2	50.5
10	44.5	37.0	36.9	35.0	37.1	37.0	37.4	53.5	39.3	37.1
11	67.3	198.9	23.9	23.6	200.3	200.1	195.3	24.4	75.3	24.8
12	133.5	128.4	124.7	122.3	128.3	128.2	142.8	26.7	202.2	124.2
13	139.8	170.6	140.5	143.4	169.4	169.3	138.3	39.6	83.2	144.1
14	42.6	43.7	42.9	41.6	45.6	45.6	41.5	43.7	44.8	42.1
15	19.8	26.7	25.4	25.8	25.7	25.8	26.5	27.8	22.9	27.2

Table 6. Cont.

16	34.1	26.9	24.5	28.0	22.0	21.5	26.7	31.3	39.1	27.5
17	51.4	32.5	35.5	36.0	37.0	37.0	31.3	32.5	33.5	32.0
18	37.8	47.3	43.7	47.0	42.7	42.7	38.7	140.7	49.1	47.4
19	40.5	40.8	40.0	46.5	44.9	45.0	41.3	132.6	38.3	46.9
20	47.7	36.0	39.7	36.0	31.0	31.0	30.9	32.5	31.5	31.1
21	215.9	29.9	39.7	73.8	33.9	33.8	34.7	33.4	34.5	34.8
22	40.4	36.4	83.3	45.0	30.6	30.6	36.9	31.1	30.0	37.2
23	21.0	21.5	27.0	27.0	28.4	28.0	28.0	28.6	28.2	28.0
24	20.3	26.5	21.7	18.0	22.3	21.9	15.5	16.6	16.4	16.6
25	13.8	15.9	15.2	67.7	16.3	16.3	16.5	16.1	16.4	15.5
26	19.1	18.5	16.7	17.0	18.6	18.6	18.7	17.0	20.9	16.5
27	22.6	23.4	25.3	25.1	23.6	23.5	23.2	15.1	18.9	25.7
28	26.8	28.7	24.2	28.1	69.7	69.7	29.2	63.6	31.4	28.7
29	28.4	28.2	182.7	16.6	32.9	32.9	33.1	31.4	32.3	33.2
30	21.3	65.3	21.2	28.8	23.4	23.4	23.4	29.7	24.5	23.7
OCH ₃						21.7			21.4	
C=O						170.7			171.2	
1'									129.7	127.4
2'									130.1	115.4
3'									128.6	144.1
4'									133.2	146.6
5'									128.6	114.3
6'									130.1	122.2
7'									165.6	144.8
8'										116.0
9'										167.8
Ref	[117]	[190]	[195]	[196]	[154]	[154]	[54]	[190]	[197]	[198]
C	O31	O32	O33	O34	O36	O37	O38	O39	O40	O41
1	38.1	38.6	38.4	53.5	39.2	38.6	38.7	38.5	42.2	42.0
2	24.4	23.7	23.7	211.1	26.4	27.2	27.3	22.5	34.4	34.1
3	80.7	80.6	80.6	83.1	78.3	78.9	79.0	80.8	216.7	216.5
4	37.6	80.6	37.8	45.9	39.3	38.7	38.8	37.8	49.0	48.7
5	51.3	55.6	55.4	54.8	55.0	55.2	55.3	55.5	56.4	56.2
6	18.2	18.2	18.3	18.8	17.5	18.3	18.5	18.5	69.7	69.4
7	32.1	34.9	32.7	33.0	32.8	33.1	32.8	32.8	42.2	42.0
8	38.0	40.8	39.9	40.1	43.4	39.3	38.8	39.7	39.9	39.6
9	153.9	51.1	47.7	47.7	61.8	47.5	47.7	47.8	51.3	51.1
10	40.7	37.2	36.9	43.8	37.1	37.0	37.6	37.1	36.8	36.6
11	115.9	21.1	23.6	23.7	200.2	23.5	23.6	23.9	21.4	21.2
12	120.7	26.2	121.8	124.1	128.3	124.6	121.8	121.9	26.1	26.0
13	147.2	38.4	145.2	140.7	170.4	140.2	145.1	145.4	38.1	37.4
14	42.8	43.3	41.8	42.9	45.4	39.5	41.8	41.9	43.5	43.3
15	25.6	27.5	26.2	24.5	26.4	25.2	26.2	26.4	27.5	27.4
16	27.2	37.7	27.0	25.4	27.3	24.3	27.0	26.0	36.9	37.3
17	32.0	34.3	32.5	35.5	32.3	35.2	32.5	32.7	34.5	34.2
18	45.6	142.7	47.4	43.6	47.6	43.4	47.4	47.4	147.6	142.4
19	46.8	129.8	46.9	40.0	45.2	39.8	46.9	47.0	124.9	129.8
20	31.1	32.3	31.1	39.7	31.0	42.5	31.1	31.3	37.4	32.1
21	34.6	33.4	34.8	34.0	34.4	33.8	34.8	23.9	28.0	33.0
22	37.1	37.4	37.2	83.2	36.5	83.1	37.2	121.9	37.4	37.1
23	28.7	28.0	28.1	29.6	28.7	28.1	28.2	145.4	25.1	23.4
24	16.9	16.6	16.8	16.8	16.4	15.6	15.5	41.9	23.6	24.8
25	20.0	16.7	15.6	16.7	15.7	15.6	15.6	26.4	17.3	16.9
26	21.0	16.1	16.9	16.9	18.7	17.0	16.9	26.0	17.7	17.6
27	25.3	14.5	26.0	24.3	23.4	25.0	26.0	32.7	14.9	14.5
28	28.2	25.3	28.4	25.2	28.2	24.0	28.4	47.4	25.5	25.0
29	33.2	31.3	33.3	182.5	33.0	182.4	33.3	47.0	70.5	31.2
30	23.7	29.2	23.7	21.2	23.5	21.0	23.7	31.3	25.7	29.0
1'	127.8	173.7	173.5					173.9		

Table 6. Cont.

2'	115.5	34.5	34.9					35.0		
3'	143.8	25.2	25.2					25.4		
4'	146.2	29.2	29.2					29.4– 29.9		
5'	114.3	29.3	29.3					29.4– 29.9		
6'	122.4	29.3	29.4					29.4– 29.9		
7'	144.4	29.7	29.6					29.4– 29.9		
8'	116.4	29.7	29.7					29.4– 29.9		
9'–13'	167.4	29.7	29.7					29.4– 29.9		
14'		29.7	29.7					31.2		
15'		29.7	29.5					23.0		
16'		31.9	31.9					14.4		
17'		22.7	22.7							
18'		14.1	14.1							
Ref	[198]	[161]	[199]	[166]	[200]	[111]	[201]	[202]	[191]	[191]
C	O42	O43^c	O44	O45	O47^d	O50	O51^a	O52^c	O53	O54
1	38.9	42.5	40.6	128.4	40.1	39.3	47.8	34.6	41.5	40.1
2	34.0	35.3	34.8	143.9	35.0	34.2	68.6	42.2	175.2	37.4
3	216.9	217.0	218.6	201.2	219.0	217.9	83.8	76.6	180.3	213.6
4	47.1	48.6	48.4	44.0	48.0	47.5	39.8	37.2	46.0	44.8
5	52.4	56.8	55.9	53.9	56.0	55.3	55.9	48.5	48.9	53.6
6	30.3	20.9	20.1	18.8	20.3	19.7	18.9	37.9	20.7	23.9
7	72.9	32.2	31.5	32.7	26.7	32.1	33.2	18.1	32.1	31.6
8	43.3	44.3	44.4	40.5	40.5	39.8	48.2	32.8	39.3	39.1
9	46.9	55.4	50.7	43.1	47.5	46.8	48.2	43.2	39.4	45.3
10	36.7	38.9	38.1	38.4	37.8	36.7	38.6	55.6	41.6	36.7
11	23.5	68.3	76.6	23.6	24.0	23.7	23.5	67.1	23.9	22.0
12	122.5	128.7	122.8	123.0	123.4	123.3	122.5	126.1	124.6	122.5
13	143.8	147.2	148.9	143.4	143.5	143.2	144.9	147.7	140.1	143.8
14	45.3	43.0	42.2	41.9	43.4	41.9	42.2	41.4	43.3	41.8
15	29.2	27.3	26.5	25.7	26.3	25.4	28.3	25.1	24.4	27.6
16	22.3	28.0	27.2	28.1	29.0	22.2	23.7	26.5	25.3	23.0
17	36.7	33.1	32.3	37.4	39.5	36.9	46.7	31.5	35.4	46.5
18	43.0	49.0	48.1	43.9	49.8	41.1	41.7	47.0	43.6	41.3
19	46.4	43.3	42.6	39.9	44.2	39.9	42.0	30.9	39.8	45.8
20	31.0	44.8	43.3	42.5	46.0	42.4	31.0	43.5	39.6	30.7
21	34.1	34.2	33.3	36.2	40.6	28.5	34.3	30.9	33.9	33.8
22	30.8	39.5	38.6	75.8	78.7	29.8	33.3	38.0	83.2	32.4
23	26.4	27.4	27.0	27.3	26.6	21.6	29.4	28.4	28.5	116.0
24	21.5	22.2	21.9	21.9	21.7	26.6	16.9	22.1	23.4	
25	15.0	17.0	16.7	20.0	15.5	15.3	17.5	16.4	19.2	13.1
26	9.7	18.9	18.4	17.5	17.2	16.7	17.7	17.8	17.2	17.0
27	25.9	26.3	25.5	25.4	26.2	25.4	26.2	26.5	23.7	25.8
28	69.6	29.3	29.0	19.9	25.8	69.0	180.2	28.4	25.2	180.4
29	33.1	29.3	29.3	184.0	34.3	184.5	33.3	28.0	182.4	33.0
30	23.8	178.9	183.3	23.8	181.0	19.2	23.8	179.2	20.7	23.5
OCH ₃			54.1						52.2	
Ref	[154]	[203]	[203]	[61]	[204]	[61]	[157]	[205]	[61]	[166]
C	O55	O56	O58^a	O60^a	O61	O62^a	O63^b	O65^b	O67^a	O68
1	36.8	39.6	33.6	38.9	33.6	37.9	38.2	38.9	38.9	38.5
2	32.4	34.4	26.2	28.1	26.2	25.1	26.6	28.2	27.6	26.7
3	217.7	217.8	75.2	78.0	70.8	81.9	79.7	79.6	73.7	78.7
4	39.1	47.7	37.8	39.7 *	47.4	55.4	38.0	40.1	42.9	38.6

Table 6. Cont.

5	55.3	55.6	49.1	55.8	49.1	46.9	48.0	56.5	48.8	55.1
6	19.5	20.0	18.6	18.8	19.7	20.3	19.5	19.0	18.7	18.2
7	33.8	32.5	32.9	33.2	32.7	32.6	33.7	33.4	33.6	32.5
8	39.3	40.1	40.3	37.3 *	39.8	39.9	39.6	41.2	39.8	39.7
9	47.4	47.1	47.7	48.1	46.7	47.1	49.6	48.9	48.2	47.5
10	46.9	37.0	37.3	37.9	37.6	37.9	39.9	37.8	37.3	36.8
11	23.6	24.0	23.8	23.8	23.5	23.5	20.2	24.4	23.8	23.4
12	122.4	123.0	123.2	122.7	121.7	120.9	124.3	123.5	122.7	123.1
13	143.6	144.3	144.4	144.7	145.1	143.0	144.7	144.5	145.0	143.2
14	41.7	42.1	42.0	42.2	41.9	42.0	43.2	43.5	42.2	41.5
15	32.2	27.3	25.9	28.3	26.0	35.9	24.7	26.5	28.4	25.2
16	21.4	26.3	23.0	24.0	26.9	73.1	27.9	29.0	23.8	21.8
17	46.6	32.7	37.6	46.6	32.5	48.6	41.2	39.5	46.7	36.7
18	41.0	46.4	41.7	41.6	47.3	41.2	56.6	49.9	42.0	41.1
19	45.8	40.5	41.4	42.0	46.7	47.5	40.0	44.3	46.5	40.1
20	30.7	42.8	42.8	35.9	31.1	30.9	43.9	46.2	31.0	42.1
21	32.4	29.2	29.5	29.6	34.7	35.8	76.0	40.7	34.3	28.4
22	26.4	36.1	30.8	32.9	37.1	32.8	41.5	78.8	33.3	29.7
23	27.7	26.8	29.2	28.4	183.2	206.4	28.7	28.3	68.2	27.9
24	15.0	21.7	22.7	16.5	24.2	10.2	17.4	16.1	13.1	15.4
25	15.0	15.5	15.7	15.3	13.1	15.4	16.1	15.7	16.0	15.3
26	17.0	17.0	17.0	17.4	16.7	17.2	16.3	17.3	17.5	16.5
27	25.8	26.1	26.0	26.2	25.9	27.1	26.7	26.3	26.2	25.7
28	183.9	28.4	68.3	180.2	28.4	174.8	21.0	25.8	180.4	68.6
29	33.0	185.1	181.5	28.2	33.3	33.2	182.3	34.1	33.3	181.7
30	23.5	19.4	20.1	65.5	23.7	24.5	25.2	181.1	23.8	19.1
Ref	[166]	[102]	[61]	[206]	[207]	[208]	[209]	[204]	[157]	[61]
C	O69^b	O70	O71^a	O72^a	O73	O75^a	O76	O77	O81	O82
1	42.0	38.1	213.0	38.5	38.5	49.6	38.3	78.7	34.9	32.5
2	28.0	23.4	45.4	28.0	27.4	170.6	23.5	172.2	25.2	26.0
3	80.0	81.0	78.4	78.1	78.7	182.0	80.8	110.9	76.0	76.1
4	39.7	37.7	40.0	39.5	38.7	45.4	37.9	36.4	37.4	37.3
5	57.1	55.4	54.7	55.3	55.2	55.2	55.2	48.8	48.7	47.3
6	68.7	18.2	18.2	18.8	18.3	20.7	18.3	17.6	18.3	18.3
7	41.6	32.6	33.2	32.9	32.6	33.4	32.6	34.5	33.0	32.5
8	40.7	39.4	39.7	41.1	39.3	41.1	39.8	41.1	43.6	37.0
9	49.4	47.6	39.7	54.8	47.6	45.9	47.5	41.0	56.4	48.9
10	37.6	37.0	52.7	37.1	37.0	38.5	36.8	40.1	38.2	33.0
11	24.5	23.4	25.7	126.0	23.1	74.5	23.7	22.1	67.6	23.4
12	124.0	122.6	123.2	127.0	122.1	121.4	121.6	24.2	126.1	122.6
13	144.4	143.6	144.1	136.6	143.4	149.8	145.2	133.5	148.0	143.7
14	43.3	41.6	42.5	42.5	41.6	43.1	41.7	45.2	41.8	41.7
15	28.8	27.7	28.3	33.3	27.7	25.8	26.1	26.4	26.0	26.0
16	24.1	22.9	23.7	25.6	23.4	27.5	26.9	39.3	28.0	32.5
17	47.9	46.6	46.8	48.7	46.6	32.9	32.5	34.6	34.7	25.2
18	41.9	41.0	42.3	133.8	41.3	47.2	47.2	133.9	45.8	35.0
19	41.4	45.7	46.2	41.0	45.8	41.6	46.7	38.7	46.7	46.6
20	36.8	30.7	31.0	32.8	30.6	36.1	31.1	33.3	36.3	50.0
21	29.3	33.6	34.3	37.5	33.8	30.0	34.7	35.4	73.9	74.0
22	33.1	32.5	33.2	36.3	32.3	36.6	37.1	36.4	45.1	36.3
23	28.4	28.1	29.0	28.5	28.1	28.2	28.1	19.3	28.3	45.4
24	17.6	17.2	16.8	16.0	15.6	23.3	16.8	24.3	22.3	28.2
25	17.3	15.2	15.0	18.4	15.3	17.7	15.6	15.0	16.7	22.3
26	18.8	16.7	18.1	17.1	16.8	17.1	16.9	18.1	18.1	16.8
27	26.5	25.9	26.0	20.1	26.0	25.5	26.0	21.3	26.3	15.2
28	181.8	184.0	180.1	178.9	181.0	28.4	28.4	23.8	28.5	26.0
29	74.4	33.1	33.3	32.4	33.1	28.2	33.3	32.3	28.9	28.3
30	19.5	23.6	23.8	24.4	23.6	65.6	23.7	24.0	16.9	29.0
1'							167.1			

Table 6. Cont.

2'										116.2
3'										144.6
4'										127.1
5'										109.2
6'										146.8
7'										147.8
8'										114.6
9'										123.0
OCH ₃		21.3								55.9
C=O		171.1								
Ref	[210]	[211]	[157]	[212]	[27]	[190]	[213]	[214]	[187]	[187]
C	O84	O85	O86	O88	O89	O90	O91	O92	O93	O94
1	39.5	39.2	38.6	38.6	38.2	39.6	39.9	41.3	41.4	38.6
2	27.4	28.2	27.2	19.0	23.7	33.8	34.0	27.6	27.7	27.1
3	78.7	78.1	79.0	79.0	80.9	218.0	217.8	78.5	78.5	78.7
4	39.0	39.4	38.8	38.8	37.8	47.0	47.2	39.5	39.1	38.6
5	55.1	55.9	55.2	55.2	55.2	54.6	55.0	55.7	55.9	55.2
6	18.4	18.9	18.4	18.4	18.3	19.4	19.7	17.9	18.0	18.0
7	32.9	33.3	32.6	32.6	32.6	33.4	34.0	35.5	35.6	34.5
8	43.3	40.1	39.8	39.8	39.8	40.3	40.7	42.8	42.9	40.7
9	49.7	48.1	47.6	47.6	47.7	50.2	50.6	56.3	56.5	50.8
10	37.9	37.3	36.9	36.2	36.9	33.7	37.0	39.4	39.5	36.9
11	81.7	23.9	23.6	23.5	23.5	21.3	21.7	70.9	71.1	20.7
12	121.2	122.5	122.3	122.2	121.7	25.9	26.3	38.3	38.6	25.7
13	153.2	144.9	144.2	144.8	145.2	38.7	38.6	37.7	37.3	37.5
14	41.8	42.5	41.7	41.7	41.7	42.5	43.4	42.8	43.0	43.5
15	26.4	26.5	25.6	26.1	28.3	27.2	27.6	27.3	27.5	27.1
16	27.4	28.7	22.0	27.2	26.2	33.9	37.7	31.5	37.6	36.4
17	32.3	38.0	36.9	32.9	32.5	40.6	34.4	39.0	34.3	37.0
18	46.9	45.4	42.3	46.3	47.3	143.4	142.6	137.5	141.6	143.1
19	46.9	46.9	46.5	29.0	46.8	127.8	130.0	134.5	129.9	127.5
20	31.2	30.9	31.0	41.0	31.2	45.1	32.4	32.2	32.4	37.0
21	34.7	42.3	34.1	36.2	34.7	215.2	33.4	33.2	33.4	73.1
22	37.0	75.6	31.0	36.9	37.1	52.3	37.4	31.1	37.3	43.7
23	28.2	28.8	15.5	15.6	28.0	24.5	26.9	28.2	28.2	27.7
24	15.5	15.9	28.1	28.1	16.7	20.7	21.0	15.5	15.6	15.8
25	18.3	16.6	15.5	15.5	15.6	13.3	16.0	16.8	17.4	16.4
26	16.8	17.3	16.7	16.8	16.8	15.6	16.0	17.4	16.9	15.8
27	24.7	25.8	25.9	26.0	25.9	14.7	14.5	14.4	14.3	13.9
28	28.5	28.8	69.7	16.8	26.9	25.6	25.3	65.4	25.3	26.7
29	33.3	33.3	33.2	26.9	33.3	28.8	31.3	29.7	31.3	28.5
30	23.7	21.2	23.6	74.8	23.7	26.3	29.2	30.5	29.2	21.4
OCH ₃					21.3					
C=O					171.0					
Ref	[215]	[216]	[217]	[218]	[219]	[191]	[220]	[191]	[220]	[191]
C	O95	O96	O97	O98	O99	O100	O101	O102		
1	38.9	40.8	38.5	38.8	31.6	38.8	34.8	38.3		
2	27.4	27.5	27.4	27.9	25.9	27.9	33.0	22.7		
3	78.9	79.1	79.0	78.6	75.7	78.6	217.0	80.9		
4	38.9	39.7	39.0	38.9	37.7	38.9	47.2	37.9		
5	55.4	55.6	55.7	51.2	44.9	51.2	48.1	55.3		
6	18.2	69.0	18.3	18.4	18.2	18.4	19.7	18.3		
7	34.6	42.2	34.7	32.2	31.9	32.2	30.4	32.5		
8	40.7	39.7	40.8	37.0	40.7	37.0	46.6	39.8		
9	51.1	51.8	51.3	154.3	154.9	154.3	53.7	47.5		
10	37.2	36.8	37.3	40.7	38.8	40.7	37.8	36.9		
11	21.0	21.2	21.2	115.8	115.3	115.8	72.1	23.5		
12	26.1	26.2	26.2	120.8	121.4	120.8	120.5	121.6		
13	38.8	37.6	39.0	147.1	145.2	147.1	152.8	145.2		

Table 6. Cont.

14	43.2	43.5	43.4	42.8	42.8	42.8	41.7	41.7
15	27.4	27.6	27.6	25.7	25.5	25.7	26.7	26.1
16	36.9	37.3	37.7	27.3	28.5	27.3	26.6	26.9
17	34.5	34.3	34.4	32.2	34.5	32.2	32.8	32.6
18	147.8	142.8	142.8	45.6	44.9	45.6	48.0	47.2
19	124.4	129.9	129.8	46.9	47.1	46.9	46.1	46.8
20	27.1	32.3	32.3	31.1	36.3	31.1	31.1	31.1
21	28.0	33.3	33.4	34.7	73.9	34.7	34.6	34.7
22	37.5	40.8	37.4	37.2	45.3	37.2	36.9	37.1
23	27.9	27.6	28.0	28.0	28.3	28.8	27.9	28.1
24	15.4	16.8	15.4	16.6	22.4	15.1	19.4	16.8
25	16.7	18.1	16.1	15.5	25.1	20.1	19.1	15.5
26	16.1	17.5	16.7	16.5	20.9	21.0	99.1	16.8
27	14.7	14.8	14.6	25.7	20.1	25.3	23.6	25.9
28	25.5	25.2	25.3	28.7	28.6	28.3	28.7	28.4
29	70.6	31.3	31.3	33.2	28.9	23.7	33.3	33.3
30	25.7	29.1	29.2	23.7	16.9	33.2	23.7	23.7
1'								127.3
2'								109.3
3'								147.0
4'								146.6
5'								114.8
6'								120.8
7'								76.4
8'								76.0
9'								62.9
OCH ₃								56.0
1'								128.5
2'								116.6
3'								143.8
4'								144.8
5'								117.5
6'								122.2
7'								143.7
8'								117.3
9'								167.0
CH ₃								20.7
C=O								170.4
Ref	[191]	[191]	[220]	[198]	[187]	[68]	[221]	[126]

Ref: References; * Values bearing the same superscript are interchangeable; NR: Not reported; Solvent: CDCl₃; ^a C₅D₅N; ^b CD₃OD; ^c CD₃COCD₃; ^d CD₃OD; ¹³C-NMR data of some compounds were not found. In these cases, the reported identification was performed by comparison of other physical data: O59 [222], O74 (m.p., IR, MS, ¹³C-NMR of acetylated compound) [102], O78 (m.p., MS, ¹H-NMR, UV, [α]_D) [223], O79 (m.p., MS, IR, UV, [α]_D) [224], O80, O83 and O87. ¹³C-NMR data of O35 [225], O46 [226], O48 [226], O49 [166], O57 [226], O64 [227], O66 [226] were reported, but the chemical shifts were not attributed to each carbon atom.

Table 7. ¹³C-NMR data of ursane-type pentacyclic triterpenoids isolated from Celastraceae species (2001–2021).

C	U1	U2	U3 ^a	U4	U5	U6	U7	U8	U9	U10
1	41.4	41.1	42.5	40.8	40.8	41.4	39.2	39.0	39.0	47.2
2	34.2	34.5	35.1	27.4	27.7	34.3	34.5	28.3	28.3	69.1
3	217.6	220.9	217.2	78.4	78.6	217.6	220.2	76.9	77.0	85.0
4	47.6	51.1	48.3	39.0	39.1	47.7	51.3	52.9	52.9	43.4
5	55.0	55.5	56.1	54.8	54.9	55.6	55.9	56.3	56.4	56.1
6	19.9	19.3	20.5	18.4	18.4	19.7	19.4	18.5	18.5	18.3
7	36.4	36.6	34.4	37.2	37.8	33.3	36.8	37.5	37.6	34.4
8	43.7	43.6	43.5	43.7	43.8	37.6	43.8	43.9	43.9	42.9
9	52.8	52.4	53.8	51.6	50.5	54.4	44.9	45.3	45.1	46.4

Table 7. Cont.

10	37.7	37.3	38.5	38.4	38.3	43.1	37.6	38.5	38.5	39.2
11	69.5	70.0	70.2	68.0	75.1	68.7	76.5	76.5	76.6	76.7
12	146.3	145.5	148.4	146.2	145.0	129.0	142.9	143.7	143.9	141.9
13	115.1	116.3	113.2	116.5	123.1	142.8	119.1	118.0	119.1	118.3
14	46.8	46.9	44.2	46.6	47.2	42.5	46.6	46.5	46.5	40.6
15	68.0	68.1	37.8	68.2	68.1	28.0	68.0	67.9	68.0	27.1
16	38.1	38.9	65.9	38.7	38.8	26.6	39.0	38.2	38.9	27.5
17	33.7	34.2	39.5	34.1	34.1	33.8	34.2	33.7	34.2	33.3
18	42.0	47.5	49.9	46.1	46.7	58.5	47.5	42.2	47.5	47.7
19	41.2	40.5	41.9	40.3	38.9	39.4	40.5	41.3	40.5	40.8
20	71.6	39.3	40.7	39.6	39.5	39.5	39.3	71.4	39.3	39.5
21	35.6	31.0	31.8	31.0	31.0	31.1	31.1	35.5	31.0	31.2
22	35.7	41.0	36.8	41.1	41.1	41.3	41.1	35.9	41.2	41.6
23	26.8	22.4	27.5	28.3	28.4	26.9	22.5	19.4	19.4	23.2
24	21.4	65.9	22.1	15.8	15.8	21.2	65.9	207.8	207.7	65.6
25	16.3	17.3	16.9	16.7	16.4	16.2	16.6	15.5	15.4	18.1
26	18.5	18.3	18.9	18.7	19.2	17.5	18.3	18.7	18.7	18.1
27	17.6	17.6	26.0	18.0	17.6	23.0	17.3	17.5	17.5	23.9
28	29.0	29.3	23.6	29.3	29.2	28.7	29.1	28.8	29.0	28.5
29	11.5	16.8	17.8	17.6	18.3	18.0	17.0	12.0	17.0	17.0
30	29.8	21.0	22.0	21.0	21.1	21.5	21.1	29.9	21.1	21.2
Ref	[193]	[193]	[190]	[54]	[54]	[228]	[193]	[193]	[193]	[193]
C	U11	U12	U13	U14	U15	U16	U17	U18^a	U19	U20
1	40.8	39.0	38.7	39.0	38.7	39.0	39.9	40.6	39.9	40.3
2	34.4	27.5	27.8	27.5	27.9	27.5	27.5	28.5	26.9	34.2
3	218.3	78.6	80.4	78.6	80.5	78.7	78.7	77.9	78.9	217.9
4	47.6	39.1	43.1	39.1	43.1	39.2	30.9	38.5	39.1	47.6
5	55.3	55.1	55.7	55.1	56.1	55.5	54.9	55.8	55.3	55.2
6	19.7	18.4	18.5	18.4	18.3	18.2	18.6	18.8	18.4	19.6
7	33.2	37.3	37.6	37.4	34.4	34.2	36.5	33.6	33.5	33.0
8	42.7	44.2	44.1	44.2	40.6	40.6	44.2	43.2	42.9	43.2
9	50.9	46.9	46.3	46.3	46.5	46.4	52.7	53.1	52.6	47.2
10	37.6	38.4	38.1	38.5	38.1	38.4	38.1	39.7	38.2	37.3
11	77.0	76.4	76.6	76.4	76.8	76.7	76.5	76.7	76.8	81.7
12	124.2	144.0	143.0	143.1	142.1	142.1	125.2	124.9	124.1	125.4
13	143.3	117.9	119.1	119.2	118.2	118.2	144.1	143.1	143.6	144.2
14	42.4	46.4	46.4	46.4	42.9	42.9	47.7	42.2	41.5	44.2
15	26.6	68.0	68.1	68.1	27.1	27.2	68.2	26.7	27.6	35.8
16	27.9	38.0	38.8	38.7	27.6	27.6	38.8	23.7	28.1	66.7
17	33.8	33.6	34.1	34.1	33.3	33.3	33.9	38.6	33.7	38.5
18	58.8	42.2	47.5	47.5	47.7	47.7	58.7	53.8	58.6	60.3
19	39.3	41.3	40.5	40.5	40.8	40.8	39.3	39.8	39.4	39.4
20	39.5	71.5	39.3	39.3	39.5	39.5	39.1	39.4	39.6	39.2
21	31.1	35.5	31.0	31.0	31.2	31.3	30.9	31.1	31.2	30.4
22	41.3	35.9	41.2	41.2	41.6	41.6	41.0	36.1	42.1	35.0
23	26.9	28.3	22.7	28.4	22.7	28.4	28.2	28.8	28.3	26.0
24	21.4	15.8	64.4	15.8	64.5	15.8	15.6	16.6	15.7	21.4
25	16.6	16.3	16.8	16.2	16.8	16.2	17.1	17.4	17.1	18.0
26	18.2	18.7	18.6	18.7	18.0	18.1	18.9	18.3	18.3	16.2
27	22.5	17.7	17.8	17.8	23.8	23.9	16.6	22.7	22.6	23.2
28	28.7	28.7	29.0	29.0	28.5	28.5	29.3	69.1	28.8	21.9
29	17.5	11.9	17.0	17.0	17.0	17.0	17.3	17.6	17.5	17.7
30	21.3	29.9	21.2	21.2	21.2	21.2	21.3	21.6	21.5	21.2
OCH ₃	54.4	52.0	51.6	51.5	51.6	51.4	54.7		53.9	
Ref	[104]	[193]	[193]	[54]	[193]	[54]	[54]	[189]	[74]	[229]
C	U21	U22	U23	U24	U25	U26^b	U27	U28	U29^a	U31
1	40.1	39.3	39.9	39.4	39.4	40.2	38.3	39.5	38.6	39.2
2	34.2	34.3	34.1	34.3	34.4	26.6	27.1	27.7	27.6	33.9

Table 7. Cont.

3	218.0	219.3	216.7	219.1	219.4	83.1	78.9	79.6	73.1	217.1
4	47.6	51.44	47.7	51.5	51.5	44.3	38.8	40.0	43.1	47.5
5	55.3	55.6	55.1	55.7	55.7	48.4	54.5	56.2	48.2	54.4
6	19.7	18.7	19.0	18.8	18.7	18.8	17.9	18.8	18.0	19.1
7	32.4	35.6	35.5	35.7	35.6	34.6	35.1	32.7	31.6	34.4
8	43.0	46.2	46.6	46.3	46.3	44.2	43.0	43.1	42.1	42.9
9	47.8	58.7	59.1	58.7	58.7	49.6	52.7	53.7	53.5	52.1
10	37.4	36.5	36.9	36.6	36.5	39.1	36.5	37.5	36.6	36.2
11	81.8	194.2	194.4	194.2	194.2	78.4	129.4	132.9	133.8	129.0
12	124.8	145.1	145.1	145.1	145.0	145.8	132.5	131.5	129.3	132.8
13	146.1	132.9	133.9	133.9	134.7	116.9	85.8	85.8	84.9	85.6
14	42.0	47.3	47.4	47.4	47.4	44.3	48.9	46.9	44.6	49.1
15	27.9	68.1	68.3	68.3	68.3	36.4	68.4	36.0	25.8	68.3
16	26.3	38.4	38.0	38.6	38.6	78.3	37.8	66.4	27.3	37.2
17	33.8	33.9	33.7	34.1	34.2	39.7	42.7	48.4	42.5	42.3
18	58.7	47.5	43.6	48.6	48.7	50.9	61.0	63.3	61.6	55.3
19	39.4	35.5	41.4	34.8	40.6	42.1	37.6	39.3	37.9	38.8
20	39.3	51.4	70.9	46.4	39.1	41.0	40.6	42.1	41.0	71.7
21	31.1	25.3	35.4	24.9	30.9	32.5	31.2	30.5	31.7	35.9
22	41.3	39.7	35.6	40.4	40.7	36.7	34.0	31.8	35.2	29.0
23	26.5	22.1	26.4	22.1	22.0	67.4	27.7	28.4	67.4	26.0
24	21.4	65.6	21.4	65.6	65.6	13.6	14.9	15.7	12.5	20.8
25	18.1	16.7	15.8	16.6	16.7	17.6	17.7	18.4	18.5	17.1
26	16.2	18.5	18.9	18.6	18.6	18.9	19.9	20.1	19.8	19.6
27	22.0	15.4	15.1	15.1	15.1	25.2	12.8	19.0	17.4	12.5
28	28.5	29.1	29.2	29.3	29.5	23.7	76.8	73.1	76.8	76.5
29	17.5	17.4	11.6	16.2	16.6	17.6	18.1	18.9	18.4	12.9
30	21.3	176.4	29.7	65.7	20.9	21.7	19.4	19.8	19.5	28.7
OCH ₃						53.5				
1'						105.8				
2'						75.7				
3'						78.4				
4'						71.8				
5'						77.6				
6'						62.8				
1''						106.1				
2''						75.7				
3''						78.3				
4''						71.6				
5''						77.8				
6''						62.9				
Ref	[229]	[193]	[54]	[193]	[54]	[230]	[54]	[189]	[189]	[193]
C	U32	U33	U34 ^a	U35	U36 ^a	U37 ^a	U38	U39	U40	U41
1	40.9	40.9	39.5	47.1	48.0	47.9	38.6	39.8	39.8	33.5
2	28.2	27.4	34.2	68.6	68.7	68.8	23.8	25.9	34.2	25.3
3	76.9	78.7	217.8	84.9	85.7	85.8	81.1	NR	217.1	75.8
4	52.8	39.0	47.4	43.4	43.9	43.9	38.1	38.7	47.8	37.5
5	55.8	54.7	55.2	55.5	56.5	56.6	55.4	56.7	55.4	48.3
6	18.6	18.5	19.6	17.6	19.1	19.3	18.3	18.8	18.8	17.4
7	35.6	35.0	32.3	33.1	33.8	33.9	32.9	34.3	32.2	32.7
8	43.8	44.7	40.0	45.5	40.2	40.7	40.2	41.3	43.7	45.3
9	52.7	55.7	46.8	59.5	48.2	48.0	47.7	49.4	60.8	61.4
10	38.3	38.2	36.6	37.4	38.2	38.3	36.9	38.0	36.6	37.0
11	70.0	67.8	23.3	194.8	24.0	24.4	23.5	24.2	199.0	200.0
12	146.1	130.2	125.3	144.4	125.7	128.1	125.1	125.1	130.6	130.7
13	116.1	142.7	138.4	134.8	138.7	139.5	138.9	140.8	164.8	164.3
14	45.9	47.0	42.2	41.7	42.4	42.1	42.2	43.3	45.5	43.7
15	72.2	72.1	25.9	27.5	29.3	29.9	26.1	26.7	27.2	27.1
16	34.2	34.5	23.3	27.3	24.4	25.9	23.7	24.1	27.4	27.5

Table 7. Cont.

17	34.0	33.9	37.9	33.4	48.3	48.6	38.1	37.7	33.8	33.8
18	47.4	58.3	54.0	48.9	53.3	54.5	54.2	55.3	58.8	58.8
19	40.6	39.1	33.7	40.8	39.4	72.7	39.5	41.4	33.5	33.5
20	39.3	39.2	46.7	39.3	39.2	42.2	39.5	40.7	46.5	46.5
21	30.9	30.8	24.5	31.1	30.8	26.8	30.7	32.2	24.8	24.6
22	40.7	40.7	34.7	41.1	36.4	37.5	35.3	36.5	40.5	40.5
23	18.7	28.2	26.4	23.0	24.2	24.2	28.2	28.3	28.8	28.4
24	207.6	15.6	21.5	65.3	65.7	65.7	17.0	17.5	22.1	22.3
25	15.7	16.8	15.5	18.3	17.5	17.4	15.8	16.3	16.0	16.4
26	19.2	18.6	16.7	18.5	17.4	17.2	16.8	17.3	18.4	18.5
27	19.5	18.7	23.3	20.9	23.9	24.6	23.4	23.9	20.5	20.7
28	28.9	28.9	69.6	28.8	176.3	177.1	69.9	70.5	28.7	28.7
29	16.8	17.5	16.9	16.6	17.5	27.1	17.5	17.8	17.0	17.0
30	21.0	21.2	66.3	21.0	21.4	16.7	21.4	21.6	65.9	65.9
OCOPh	165.5	165.6								
iso	131.0	131.0								
orto	129.5	129.5								
meta	128.8	128.4								
para	132.9	132.8								
1'					93.7	93.8	127.2	127.3		
2'					79.2	79.1	114.0	129.5		
3'					78.9	79.1	144.8	115.8		
4'					70.7	70.8	147.2	157.4		
5'					79.2	79.2	115.3	115.8		
6'					62.1	62.2	122.1	129.5		
7'							150.0	143.8		
8'							115.7	116.4		
9'							167.9	167.2		
1''					104.8	104.7				
2''					76.0	75.9				
3''					78.4	78.4				
4''					72.7	72.9				
5''					78.3	78.3				
6''					63.7	63.9				
Ref	[54]	[54]	[185]	[193]	[194]	[194]	[231]	[204]	[185]	[185]
C	U42	U43	U44	U45	U46	U47	U48	U49	U50	U51 ^a
1	40.5	40.7	41.7	38.7	38.5	38.7	39.0	39.3	38.9	39.8
2	28.2	28.2	28.3	27.0	27.8	27.0	27.6	27.2	27.6	28.1
3	76.9	76.9	77.9	78.6	76.9	78.6	80.5	78.7	80.6	77.9
4	52.8	52.8	49.3	38.8	52.7	38.8	43.0	39.0	43.1	39.8
5	56.2	56.2	56.3	55.1	56.2	55.1	55.2	54.6	55.5	55.3
6	18.6	18.5	20.2	18.6	18.7	18.6	17.8	17.7	17.6	18.0
7	37.1	37.2	37.3	39.1	39.0	39.2	36.4	36.2	33.2	33.2
8	43.6	43.7	43.8	38.2	38.3	38.2	46.7	46.7	45.5	45.7
9	52.6	52.9	53.3	58.0	56.7	57.9	59.7	59.8	59.7	61.3
10	38.2	38.3	38.4	38.1	38.3	38.1	37.0	37.3	36.9	37.4
11	69.7	70.1	70.2	72.8	73.1	73.0	194.9	195.1	195.1	199.3
12	146.5	145.7	145.7	207.1	206.7	207.1	144.9	144.9	144.5	130.7
13	115.1	116.7	116.6	42.7	42.9	43.0	134.2	134.0	134.4	163.6
14	46.6	46.6	46.7	49.9	49.3	49.5	47.2	47.2	41.7	45.8
15	68.0	68.1	68.1	66.0	66.1	66.2	68.3	68.4	27.5	37.1
16	38.1	38.9	38.8	37.2	38.0	37.8	38.6	38.5	27.3	64.7
17	33.6	34.2	34.1	32.6	33.2	33.1	34.2	34.2	33.4	39.2
18	42.0	47.4	47.3	35.3	39.6	39.5	48.7	48.7	48.9	60.7
19	41.3	40.5	40.5	41.4	40.5	40.5	40.4	40.4	40.8	39.1
20	71.6	39.3	39.3	71.3	37.9	38.0	39.1	39.1	39.3	39.4
21	35.6	31.0	31.0	35.2	30.8	30.8	30.9	30.9	31.2	30.8
22	35.7	41.0	41.0	36.0	41.5	41.5	40.7	40.7	41.1	35.4
23	19.3	19.3	23.8	27.8	19.2	27.9	22.4	28.0	22.4	28.7
24	207.8	207.9	178.4	15.3	207.1	15.2	64.3	15.6	64.3	16.6

Table 7. Cont.

25	15.8	15.8	14.4	17.3	16.2	17.3	17.1	16.6	17.1	17.0
26	18.7	18.6	18.5	21.2	20.9	21.1	19.0	19.1	18.4	18.7
27	17.7	18.0	17.8	18.1	17.7	17.9	15.2	15.3	20.9	21.9
28	29.0	29.3	29.3	27.9	28.2	28.2	29.4	29.4	28.8	23.0
29	11.4	16.8	16.7	11.7	16.6	16.6	16.6	16.5	16.5	17.6
30	29.9	21.1	21.0	29.1	20.5	20.5	20.9	20.9	21.0	21.2
OCH ₃			51.3							
Ref	[193]	[54]	[54]	[193]	[193]	[193]	[193]	[54]	[54]	[190]
C	U52 ^a	U54	U55	U56	U57 ^c	U58	U59	U60	U62	U63 ^a
1	38.5	39.2	38.4	38.1	37.9	38.6	38.5	38.1	38.5	40.5
2	27.6	27.3	27.5	23.4	28.7	23.8	23.7	26.8	23.6	36.1
3	72.8	78.8	78.0	80.7	80.0	81.2	80.6	78.5	80.6	216.0
4	43.1	39.1	42.3	37.9	42.8	37.9	37.8	38.7	37.7	54.7
5	48.1	54.8	54.6	55.0	52.5	55.5	55.3	54.6	55.3	49.2
6	17.9	17.5	19.3	17.7	18.5	18.4	18.3	17.5	18.2	67.8
7	33.0	32.8	33.3	31.4	33.3	33.1	32.9	31.0	32.9	41.6
8	42.1	45.1	40.9	41.8	39.9	40.2	40.1	41.5	40.0	42.6
9	48.9	61.6	51.1	53.0	48.7	47.8	47.7	52.8	47.6	46.6
10	37.0	36.9	31.0	36.4	37.1	37.0	36.8	36.1	36.8	37.8
11	37.4	199.8	73.3	133.4	24.4	23.6	23.4	128.6	23.4	77.3
12	209.8	130.7	126.0	129.0	128.0	124.5	124.4	133.2	124.3	145.0
13	89.4	164.3	140.4	89.7	140.2	139.8	139.7	89.5	139.6	116.5
14	45.9	43.6	42.5	42.0	41.7	42.4	42.1	41.7	42.1	41.4
15	26.3	27.1	28.4	25.6	30.6	28.3	26.6	25.3	26.6	27.6
16	26.4	27.5	26.0	30.9	27.6	26.8	28.1	22.6	28.1	28.0
17	42.7	33.8	47.8	45.2	47.0	33.9	33.8	44.9	33.7	33.7
18	55.0	58.8	53.5	40.4	54.6	59.3	59.1	60.4	59.1	47.5
19	38.0	33.5	72.1	38.2	72.4	39.8	39.6	37.9	39.6	41.3
20	40.7	46.5	42.5	60.7	39.7	39.8	39.7	40.1	39.7	40.0
21	31.6	24.9	27.4	22.9	26.8	31.5	31.3	30.6	31.2	31.6
22	34.9	40.5	38.3	31.3	38.5	41.7	41.6	31.1	41.5	42.2
23	67.2	28.0	180.6	27.8	68.4	28.3	28.1	27.6	28.1	66.8
24	12.9	22.1	13.7	16.1	12.8	16.9	16.8	14.7	16.8	20.5
25	16.1	16.5	16.7	19.2	17.0	16.0	15.7	17.7	15.7	17.6
26	18.7	18.5	16.9	19.0	16.8	17.7	16.9	18.7	16.9	20.3
27	17.7	20.6	23.9	16.2	25.0	23.4	23.3	15.9	23.2	24.0
28	77.2	28.7	68.7	18.1	64.5	29.1	28.8	179.6	28.7	28.9
29	19.1	17.0	17.4	17.9	27.1	17.0	17.5	17.6	17.5	17.4
30	19.8	65.9	28.6	179.9	16.2	21.6	21.4	18.9	21.4	21.5
OCH ₃			55.4							51.4
OCH ₃			21.7	21.4	21.2	21.5				
C=O			170.4	171.1	169.9	171.5	173.5		173.7	
2'							34.9		34.9	
3'							25.2		25.2	
4'										
13'							29.2–29.7		29.2–29.5	
14'							29.7		31.9	
15'							29.5		22.7	
16'							31.9		14.1	
17'							22.7			
18'							14.1			
Ref	[189]	[185]	[232]	[233]	[232]	[234]	[235]	[236]	[6]	[190]
C	U64 ^c	U65	U66 ^a	U67	U68	U69 ^a	U71	U72	U73 ^c	U74
1	38.9	43.0	39.4	39.5	39.5	48.0	39.7	33.6	34.1	38.4
2	29.3	175.5	34.8	34.2	34.2	68.6	34.1	25.8	25.7	26.8
3	208.1	207.7	216.2	217.9	217.8	83.7	217.3	74.2	76.3	77.4
4	47.2	50.7	47.4	47.5	47.5	39.9	47.7	37.4	42.6	38.4
5	55.6	47.7	55.2	55.3	55.3	55.9	55.2	48.1	54.1	54.8

Table 7. Cont.

6	19.8	20.4	19.8	19.7	19.7	18.9	18.6	17.1	19.0	18.2
7	34.0	32.1	32.5	32.3	32.4	33.5	32.4	32.9	33.2	32.3
8	40.2	40.0	40.3	40.2	40.1	40.1	44.5	44.6	41.3	39.6
9	46.6	40.4	47.1	46.9	46.9	47.0	60.7	61.2	48.1	47.2
10	37.5	42.3	36.7	36.7	36.7	38.5	36.1	37.2	37.4	38.4
11	24.5	23.8	23.8	23.7	23.7	23.8	199.5	199.3	73.1	23.0
12	127.9	125.1	125.2	125.5	125.8	125.5	130.7	130.3	127.3	124.8
13	138.8	139.1	139.3	138.0	137.9	139.3	163.5	163.3	139.4	138.0
14	42.0	42.7	43.1	42.6	42.2	42.6	43.8	43.6	43.1	42.2
15	28.7	26.5	26.5	26.3	25.9	28.7	28.5	28.3	27.7	25.5
16	26.6	29.2	21.4	27.5	23.3	24.9	23.7	23.9	25.9	20.3
17	48.4	35.2	39.7	38.0	37.9	48.1	47.7	47.0	48.9	36.4
18	54.3	58.6	58.3	52.8	53.0	53.6	52.8	52.8	54.5	57.2
19	73.2	38.4	34.8	34.0	34.1	39.4	38.6	38.1	71.9	33.6
20	41.8	47.1	51.2	45.1	51.8	39.5	38.6	38.4	44.0	49.7
21	27.0	71.8	34.4	32.4	25.1	31.0	30.3	30.1	27.2	33.1
22	39.1	50.3	77.6	74.8	34.3	37.5	36.7	36.0	38.6	76.7
23	23.5	23.9	26.7	26.7	26.7	29.4	26.6	28.8	177.4	28.0
24	181.1	19.5 *	21.6	21.6	21.6	17.7	21.3	22.1	13.1	15.3
25	15.0	19.4 *	15.4	15.5	15.5	17.0	15.5	16.0	16.4	15.7
26	17.0	16.9	16.9	16.8	16.8	17.5	19.0	18.7	17.7	16.4
27	25.3	22.9	23.8	23.8	23.5	23.9	20.9	20.4	25.2	23.1
28	65.4	28.4	25.2	21.7	69.3	179.9	180.0	180.0	179.7	24.3
29	26.9	17.4	19.0	18.5	18.0	17.5	17.0	16.5	27.7	17.9
30	16.8	15.8	178.2	182.1	181.6	21.4	21.0	20.4	17.9	177.0
Ref	[232]	[54]	[129]	[61]	[61]	[157]	[185]	[185]	[232]	[237]
C	U75	U76	U77^d	U78^a	U79	U80	U81	U82	U83^a	U84
1	42.7	38.1	39.0	48.0	40.0	40.9	40.4	40.8	33.9	38.8
2	34.5	23.8	28.3	68.6	34.4	27.3	27.8	27.4	28.4	27.3
3	74.6	80.8	79.1	83.9	NR	78.5	80.6	78.7	78.8	79.0
4	45.4	37.5	39.2	39.8	47.9	39.0	43.0	39.0	38.9	38.8
5	49.9	55.1	55.5	56.1	55.6	54.8	55.8	54.9	55.4	55.4
6	19.3	18.0	18.6	19.0	19.0	18.5	18.4	18.5	18.1	18.4
7	66.9	32.7	33.3	33.6	32.4	37.0	33.9	36.7	33.2	32.9
8	40.9	39.3	38.9	40.7	43.9	44.1	42.7	44.6	40.3	39.4
9	48.9	47.3	47.8	47.9	60.9	54.4	54.4	55.7	48.6	47.8
10	39.1	36.9	37.1	38.5	36.8	38.2	37.8	38.2	41.4	37.2
11	24.6	23.4	23.6	24.2	199.2	69.9	70.1	68.1	25.2	23.4
12	126.7	125.5	125.8	128.2	130.5	145.7	144.7	129.8	125.7	125.0
13	139.7	137.8	138.5	139.5	165.5	117.0	115.8	143.5	138.9	138.0
14	43.3	41.6	42.3	42.1	45.1	46.5	40.9	47.7	42.3	42.8
15	29.2	27.9	27.0	29.8	29.8	68.2	26.9	68.0	26.7	29.2
16	25.3	23.9	24.5	26.8	27.4	38.7	27.6	38.8	28.2	22.6
17	48.6	47.8	48.1	48.6	34.3	34.1	33.2	34.0	33.7	36.8
18	54.4	52.3	53.1	54.5	59.2	47.3	47.7	58.3	59.0	54.1
19	40.4	38.8	39.4	72.7	39.4	40.5	40.8	39.1	34.1	38.9
20	40.4	38.7	39.7	42.2	39.4	39.3	39.5	39.2	47.3	39.4
21	31.8	30.4	30.9	25.9	31.0	31.0	31.2	30.9	25.3	30.7
22	38.1	36.5	37.2	37.5	41.0	41.1	41.5	40.9	41.2	30.6
23	23.1	27.9	28.3	29.4	26.5	28.2	22.6	28.2	29.0	28.1
24	65.9	16.9	17.1	17.6	21.6	15.6	64.4	15.6	16.1	15.4
25	17.4	15.5	15.7	17.4	15.9	16.7	17.3	16.8	61.0	15.6
26	21.6	16.5	15.9	16.7	18.5	18.6	17.9	18.6	17.4	16.9
27	24.1	23.9	23.8	24.7	20.6	18.2	24.1	17.2	23.7	23.4
28	181.6	184.0	181.1	177.0	29.0	29.3	28.7	29.3	28.7	69.7
29	17.6	16.8	17.3	27.0	17.6	16.8	16.7	17.5	17.1	16.2
30	17.7	21.0	21.5	17.0	21.3	21.1	21.1	21.3	65.9	21.3

Table 7. Cont.

1'				93.7						
2'				79.3						
3'				79.0						
4'				70.9						
5'				79.1						
6'				62.4						
1''				104.8						
2''				75.9						
3''				78.3						
4''				72.9						
5''				78.1						
6''				63.9						
Ref	[238]	[239]	[240]	[241]	[242]	[54]	[193]	[54]	[243]	[244]
C	U85	U86	U88							
1	38.8	37.7	36.8							
2	27.4	27.1	25.2							
3	79.0	79.1	78.2							
4	38.8	38.7	38.4							
5	55.3	55.4	50.7							
6	18.4	18.8	17.9							
7	34.6	41.8	31.6							
8	41.0	38.9	40.2							
9	50.5	49.2	154.0							
10	37.2	37.9	38.2							
11	22.2	17.4	114.9							
12	24.7	32.2	122.5							
13	135.4	40.0	140.7							
14	45.0	159.2	42.6							
15	26.8	116.3	27.8							
16	38.9	40.6	25.7							
17	34.0	33.9	33.2							
18	136.4	60.4	56.8							
19	36.7	35.4	38.5							
20	35.0	36.5	38.9							
21	23.7	28.5	30.7							
22	36.3	38.5	40.9							
23	28.1	28.0	28.2							
24	15.5	15.5	16.9							
25	16.3	15.2	17.1							
26	17.8	26.3	21.6							
27	21.9	19.4	24.9							
28	28.3	37.0	29.2							
29	23.1	27.5	17.1							
30	20.5	22.5	21.0							
Ref	[245]	[245]	[246]							

Ref: References; * Values bearing the same superscript are interchangeable; NR: Not reported; Solvent CDCl₃; ^a Pyridine-d₅; ^b CD₃OD; ^c CDCl₃ + DMSO-d₆; ^d CDCl₃+CD₃OD; ^e ¹³C-NMR data of some compounds were not found. In these cases, the reported identification were performed by comparison of other physical data: U30, U53 [247], U70 (¹H-NMR, IR, MS) [248] e U87 (m.p., [α]_D, IR, ¹H-NMR) [249].

Table 8. ^{13}C -NMR data of pentacyclic triterpenoids classified as others isolated from Celastraceae species (2001–2021).

C	OT3	OT4	OT5	OT6	OT7	OT8	OT9 ^a	OT10 ^a	OT11 ^a	OT12
1	39.6	38.9	104.6	18.2	37.8	37.2	104.5	106.2	121.3	36.6
2	34.2	27.5	144.7	27.8	27.1	194.7	147.5	146.9	182.0	34.8
3	218.2	78.4	144.2	76.3	79.0	200.1	144.2	144.4	182.2	217.1
4	47.4	39.0	118.0	40.8	38.7	123.8	118.1	128.7	131.4	47.6
5	54.9	55.3	129.8	141.6	55.5	154.8	129.8	117.6	142.1	53.2
6	19.7	18.5	122.5	122.0	18.8	75.0	122.6	121.6	121.3	26.3
7	33.7	33.4	127.9	23.5	41.3	122.9	127.9	130.0	153.2	22.6
8	41.6	41.7	131.3	47.8	38.9	154.0	131.3	141.7	47.6	41.0
9	49.6	50.4	135.6	34.8	49.2	51.6	135.3	132.2	144.8	147.4
10	36.8	37.2	129.5	49.6	38.0	71.6	129.5	131.8	158.2	39.3
11	21.6	21.1	25.5	34.6	17.5	28.2	29.3	129.0	128.3	115.6
12	23.9	24.0	32.8	30.5	37.7	29.5	35.9	138.1	38.9	36.1
13	49.6	49.5	102.5	37.7	36.0	38.2	54.5	44.1	41.6	36.7
14	42.1	42.1	43.6	39.5	158.0	40.3	156.8	49.0	43.2	38.2
15	32.6	33.7	38.8	32.5	116.9	28.5	34.1	31.3	24.8	29.6
16	21.6	21.7	40.2	35.7	33.6	35.6	41.4	38.8	38.6	35.8
17	54.9	54.9	42.6	30.5	37.6	30.7	41.6	32.4	33.2	42.8
18	44.7	44.8	46.0	41.9	48.0	43.4	50.4	43.2	48.2	52.0
19	41.9	41.9	32.8	39.3	31.1	30.6	36.8	32.7	32.6	20.1
20	27.3	27.4	40.2	33.1	33.8	41.7	41.9	41.9	41.7	28.2
21	46.4	46.5	36.8	29.5	28.1	29.9	30.8	31.0	31.1	59.6
22	148.6	148.6	36.9	27.9	35.3	35.9	35.5	36.2	34.5	30.7
23	26.6	28.2	11.6	28.9	28.0	9.5	11.6	11.6	11.2	22.0
24	21.1	15.7		25.4	15.5					25.5
25	15.7	16.7	20.5	16.1	15.4	27.0	20.7	19.5	27.7	21.6
26	16.4	15.9	23.2	18.1	25.9	21.5	28.0	20.1	20.5	16.9
27	16.6	16.7	23.2	20.4	21.1	28.7	108.3	23.4	20.5	15.3
28	16.1	16.1	25.1	32.0	29.9	31.7	31.3	31.7	31.8	13.9
29	110.1	110.2	180.5	74.4	73.9	178.8	184.7	183.6	183.2	22.1
30	25.0	25.0	26.3	26.0	24.6	32.5	25.9	32.5	34.0	23.0
Ref	[94]	[94]	[139]	[213]	[213]	[250]	[139]	[139]	[139]	[251]
C	OT13	OT14	OT15	OT17	OT18	OT19	OT20	OT21		
1	110.7	110.6	98.9	38.5	18.2	23.6	36.1	38.1		
2	163.7	163.7	143.2	27.4	27.8	18.1	27.8	27.3		
3			178.1	79.0	76.3	76.2	79.0	79.2		
4	24.7	28.2	40.1	39.0	40.8	39.2	39.6	39.1		
5	103.7	105.6	43.3	55.7	141.7	141.6	52.3	55.7		
6	126.4	125.8	28.2	18.3	122.0	121.9	21.4	19.0		
7	115.9	115.9	17.3	34.7	23.8	27.7	26.7	35.3		
8	161.1	160.4	47.7	40.8	45.7	43.0	41.0	38.9		
9	39.6	39.5	38.8	51.3	34.8	34.8	148.9	48.9		
10	165.2	166.1	47.8	37.3	49.7	46.6	39.1	37.9		
11	33.4	33.3	33.9	21.2	29.9	34.6	114.3	17.7		
12	29.7	29.7	28.7	26.2	29.7	30.3	36.0	35.9		
13	40.5	40.3	38.9	39.0	38.4	37.7	36.8	37.9		
14	44.1	44.1	37.6	43.4	38.6	40.7	38.2	158.1		
15	28.4	28.4	28.8	27.6	34.3	32.0	29.7	117.0		
16	35.5	35.5	35.9	37.7	36.3	35.9	35.9	36.9		
17	38.2	38.2	30.1	34.4	32.9	30.0	43.0	38.1		
18	43.4	43.4	44.2	142.8	44.7	47.4	52.1	49.4		
19	32.0	32.1	30.2	129.8	35.8	35.1	20.2	41.4		
20	41.9	41.9	40.3	32.3	34.5	28.2	28.2	29.0		
21	213.8	213.7	29.9	33.4	74.7	33.0	59.6	33.9		
22	52.5	52.5	36.2	37.4	46.3	38.9	30.8	33.2		
23			7.9	28.0	25.4	28.9	28.2	28.1		
24			99.4	15.4	28.9	25.4	15.6	15.6		
25	36.8	36.5	17.5	16.1	16.6	16.2	22.1	15.6		

Table 8. Cont.

26	22.5	22.5	15.9	16.7	17.0	18.4	17.0	30.1
27	19.7	19.8	17.2	14.6	19.1	19.6	15.3	26.0
28	32.5	32.6	31.6	25.3	33.1	32.4	14.0	30.1
29			179.0	31.3	32.3	34.6	23.0	33.5
30	15.1	15.1	31.8	29.2	24.6	32.0	22.2	21.5
OCH ₃	50.5	51.0	51.3					
Ref	[252]	[252]	[196]	[220]	[196]	[157]	[253]	[254]

Ref: References; NR: Not reported; Solvent CDCl₃; ^a CD₃OD; ¹³C-NMR data of some compounds were not found. In these cases, the reported identification was performed by comparison of other physical data: OT1 (m.p., [α]_D, IR, ¹H-NMR) [255], OT2 e OT16 (m.p., [α]_D, IR, ¹H-NMR, MS) [256].

4. Conclusions

This review describes 504 pentacyclic triterpenoids isolated from Celastraceae species, classified as aromatics (29), dimers (50), friedelanans (103), lupanes (89), oleananes (102), quinonemethides (22), ursanes (88) and others (21). The data reported highlights the abundance and structural diversity of pentacyclic triterpenes isolated from plants of this family. The chemical complexity of these compounds helps to rationalize the various biological properties associated with these plant species, as well as these pure metabolites. The compilation of PCTTs ¹³C-NMR data presented in this review represents a contribution to the structural elucidation of new compounds of this class of terpenes.

Supplementary Materials: The following are available online, Table S1: Pentacyclic triterpenoids isolated from Celastraceae species (2001–2021) [257–320].

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