

S3 Appendix: Phytochemicals associated with *Ulva*, *Zostera* and *Cymodocea* species with their reported biological activity.

| Macrophyte species and origin | Detected and identified compounds | Reported biological activities | Reference |
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| <i>Ulva</i> spp. | | | |
| <i>Ulva rigida</i> (Ras-Djebel, Tunisia) | Polyphenols: Phloroglucinol / Feruloyl-hexose / Fucodiphloroethol / Vanillic acid / Fucophloroethols derivatives / Quinin acid / Dieckol / Fucophloroethol / Syringic acid / Phloroecol / Dihydroxybenzoic acid / Phenylethanol / Dioxinodehydroeckol / Eckol / Diphloroethohydroxycarmalol. | Radical-scavenging activity. Not toxic to HeLa cells culture. | Mezghani et al. 2016 |
| <i>Ulva intestinalis</i> (Fenghua coast, China) | Three algicidal compounds: 15-ethoxy-(6z,9z,12z)-hexadecatrienoic acid / (6E,9E,12E)-(2-acetoxy-β-D-glucose)-octadecatrienoic acid ester / Hexadecanoic acid. | Algicidal activity against red tide microalgae | Sun et al. 2016 |
| <i>Ulva rigida</i> (Ria Formosa, Portugal) | Fatty acids: Linoleic / α-linolenic / Stearidonic / γ-linolenic / Arachidonic / Eicosapentaenoic / Oleic / Palmitoleic. Polyunsaturated aldehydes (detected upon tissue damage): 2,4-Heptadienal / 2,4-decadienal / 2,4,7-decatrienal. | Not Tested | Alsufyani et al. 2014 |
| <i>Ulva rigida</i> (Sidi Mansour, Sfax, Tunisia) | Fatty acids: Palmitic / Oleic / Linolenic / Eicosenoic / Linoleic / Palmitoleic / Stearic / Myristic / Arachidic. | Antibacterial, antimicrobial and antioxidant activities. Acetylcholinesterase inhibitory capacity. | Trigui et al. 2013 |
| <i>Ulva fasciata</i> (South-West coast of India) | Seven labdane diterpenoids: Labda-14-ene-8-ol / labda-14-ene-3α,8α-diol / Labda-14-ene-8α,9α-diol / Labda-14-ene-8α-hydroxy-3-one / ent-Labda-13(16),14-diene-3-one / ent-Labda-13(16),14-diene / ent-Labda-13(16),14-diene-3α-ol. | Antibacterial activity. | Chakraborty et al. 2010 |
| <i>Ulva fasciata</i> (South-Western India) | Five major sesquiterpenoids: 2,5,5-Trimethyl-4-(4'-methyl-3'-pentenyl)-2-cyclohexen-1-ol / 4-Isopentyl-3,4,5,5-tetramethyl-2-cyclohexen-1-ol / 4-Isopentyl-3,4,5,5-tetramethyl-2-cyclohexen-1-ol / 6-Isopentyl-1,5,5,6-tetramethyl-1-cyclohexene / 3,4,5,5-Tetramethyl-4-(3'-oxopentyl)-2-cyclohexen-1-one. | Radical-scavenging activity. | Chakraborty and Paulraj 2010 |
| <i>Ulva fasciata</i> (Abu-Qir, Egypt) | Three new fatty acids: (E)-11-oxo-octadeca-12-enoic acid / (E)-11-hydroxy-octadeca-12-enoic acid / 6-hydroxy-oct-7-enoic acid. Unpolar fractions: Dimethylsulfoxide / Dimethylsulfone / 4-Oxo-pentanoic acid / Dodecane / Tridecane / 1,1'-Bicyclohexyl / Phenylacetamide / 6,10,14-Trimethyl-pentadecan-2-one / 8-Heptadecene / Hexadecanoic acid. | Antimicrobial activity. Weak cytotoxicity against brine shrimps. Potent antitumor activity against breast carcinoma tumor cell line MCF7. | Abou-Elwafa et al. 2009 |
| <i>Ulva fasciata</i> , <i>Ulva pertusa</i> , <i>Ulva arasakii</i> , <i>Ulva conglobata</i> (Nagasaki, Japan) | Three algicidal compounds = Polyunsaturated fatty acids (PUFAs): Hexadeca-4,7,10,13-tetraenoic acid / Octadeca-6,9,12,15-tetraenoic acid / α-linolenic acid. Other Fatty acids: Decanoic / Myristic / Myristoleic / Palmitic / Stearic / Elaidic / Oleic / Linolic / Eicosenoic / Behenic / Erucic. | Algicidal activity against phytoplankton species. | Alamsjah et al. 2008 |
| <i>Ulva fasciata</i> (**) | Fatty acids: α-linolenic acid and linoleic acid. | Algicidal activity against red tide microalgae. Toxic to the rotifer <i>Brachionus plicatilis</i> . Low toxicity against fish (<i>Inimicus japonicus</i>), brine shrimp (<i>Artemia sp.</i>) and mammalian cell lines (U937, HeLa, Vero, and CHO cells). | Alamsjah et al. 2007 |
| <i>Ulva fasciata</i> (Coast of Nagasaki Prefecture, Japan) | Three algicidal compounds = Polyunsaturated fatty acids (PUFAs): Hexadeca-4,7,10,13-tetraenoic acid / Octadeca-6,9,12,15-tetraenoic acid / α-linolenic acid. | Algicidal activity against red tide microalgae. | Alamsjah et al. 2005 |
| <i>Ulva lactuca</i> (Abou-Kir, Egypt) | Steroid: 3-O-β-D glucopyranosyl-stigmasta-5,25-dien (3-O-β-D-glucopyranosyl clerosterol). | Antiinflammatory and antimicrobial activities. | Awad et al. 2000 |
| <i>Ulva curvata</i> (Shem Creek, Charleston Harbor, USA) | Enzyme: Dimethylsulfoniopropionate (DMSP) lyase (responsible for producing dimethylsulfide in marine environments) | Not Tested | De Souza et al. 1996 |
| <i>Ulva rigida</i> (Black Sea) | Sterols: Fucosterol (= main sterol component). | Not Tested | Popov et al. 1985 |

| Zostera spp. | | | | |
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| <i>Zostera noltei</i> <i>Zostera marina</i> (Algarve, Southern Portugal) | Fatty acids: Palmitic / Linoleic / α -linolenic / Myristic / Margaric / Stearic / Arachidic / Behenic / Lignoceric / Palmitoleic / Oleic / Hexadecatrienoic / Arachidonic / Eicosapentaenoic / Docosahexaenoic acids. Pentadecanoic acid detected only in <i>Z. marina</i> . | Phenolic acid: Rosmarinic acid. | Radical scavenging activity. <i>Z. marina</i> :Capacity to chelate copper <i>Z. noltei</i> : Capacity to chelate copper and iron ions. Toxicity against HepG2, S17 and neuroblastoma cell lines. | Custódio et al. 2016 |
| <i>Zostera noltii</i> , <i>Zostera marina</i> (Thau lagoon and Arcachon bay, France) | | Phenolics: Zosteric acid / Rosmarinic acid / Flavonoids. | Algicidal activity against the neuro-toxic bloom-forming dinoflagellate <i>Alexandrium catenella</i> . | Laabir et al. 2013 |
| <i>Zostera marina</i> (Qingdao, China) | | Phenolic acid: Rosmarinic acid. | Nematicidal and antibacterial activities against PWN (Pine Wood Nematode) and its carrying bacteria. | Wang et al. 2012 |
| <i>Zostera noltii</i> (Bays of Arcachon, France; Cadiz, Spain) | | Phenolics: Zosteric acid / Caffeic acid / Luteolin 7-sulfate / Apigenin 7-glucoside / Apigenin 7- sulfate / Diosmetin 7-sulfate / Luteolin / Apigenin / Diosmetin. | Not Tested | Grignon-Dubois and Rezzonico 2012 |
| <i>Zostera noltii</i> (Bays of Cadiz, Sa Nitja and Alfacs, Spain ; Arcachon lagoon, France) | | Phenolics: Rosmarinic acid / Zosteric acid / Caffeic acid. | Not Tested | Grignon-Dubois et al. 2012 |
| <i>Zostera noltii</i> <i>Zostera marina</i> (Arcachon lagoon, France) | | Phenolics: Rosmarinic acid / traces of Caffeic acid. | Not Tested | Achamlale et al. 2009a |
| <i>Zostera noltii</i> <i>Zostera marina</i> (Arcachon lagoon, France) | | Phenolic acid: Zosteric acid. | Not Tested | Achamlale et al. 2009b |
| <i>Zostera marina</i> (Roscoff, France) | | Phenolics: Gallic acid/ Caffeic acid / <i>p</i> -coumaric acid/ Ferulic acid. | Caffeic acid: Potential growth-limiting properties against <i>Labyrinthula zosterae</i> . | Vergeer and Develi 1997 |
| <i>Zostera marina</i> (Øresund, Denmark) | | Phenolics: Rosmarinic acid / Caffeic acid. | Not Tested | Ravn et al. 1994 |
| <i>Zostera marina</i> (Monterey Bay, California) | | Phenolic acid: <i>p</i> -(sulphoxy) Cinnamic acid. | Antifouling activity. | Todd et al. 1993 |
| <i>Zostera marina</i> (Great Bay, USA) | | Phenolics: Caffeic acid derivative / Luteolin-7,3'-disulfate / Luteolin-7- sulfate / other flavones. | Not Tested. Potential growth-limiting properties against <i>Labyrinthula</i> "P." | Buchsbaum et al. 1990 |
| <i>Zostera marina</i> (Puget Sound, Washington, USA) | | Phenolics: Ferulic / Vanillic / <i>p</i> -hydroxybenzoic / Caffeic / Gallic / Protocatechuic / Gentisic acids. | Not Tested | Quackenbush et al. 1986 |
| <i>Zostera marina</i> (Roberts Bank, Canada) | | Phenolics: Caffeic / Protocatechuic / Gentisic (=not detected or isolated, pure phenolic acids tested) | Algicidal activity against the microalgae (<i>Platymonas sp.</i>). Antibacterial activity. Amphipod grazing inhibition. | Harrison et al. 1982 |
| <i>Zostera noltii</i> (Spain) | | Phenolics: <i>p</i> -Coumaric / <i>p</i> -Hydroxybenzoic. | Not Tested | Zapata and McMillan 1979 |
| <i>Zostera marina</i> (Washington) | | Phenolics: Caffeic / Protocatechuic / <i>p</i> -Coumaric / <i>p</i> -Hydroxybenzoic / Ferulic / Vanillic / Gentisic / Gallic. | Not Tested | |
| <i>Zostera marina</i> (Plymouth, U.K) | | Five Flavone sulfates: 7-sulphates of Apigenin, Luteolin, Diosmetin and Chrysoeriol / 7.3'-disulphate of luteolin | Not Tested | Harborne and Williams 1976 |
| <i>Zostera nana</i> (Bucknall; Isle of Wight, U.K) | | Two Flavone sulfates: Luteolin 7-sulphates / Diosmetin. | Not Tested | |

| Cymodocea spp. | | | | |
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| <i>Cymodocea nodosa</i> (Chebba coast, Tunisia) | Sulfated polysaccharide | Anti-hypertensive properties. | Ben Abdallah Kolsi et al. 2016 | |
| <i>Cymodocea serrulata</i> (Coast of Tuticorin, India) | Phenyl thioketone | Antibacterial activity. | Gnanambal et al. 2015 | |
| <i>Cymodocea serrulata</i> (Arockiapuram coast, India) | Fatty acids and related esters: 2-pentadecanone, 6,10,14-trimethyl / 1,2-benzenedicarboxylic acid butyl 1,2-methylpropyl ester / octadecanoic acid methyl ester / 1,2-benzenedicarboxylic acid diisooctyl ester / Oleic acid / Erucic acid. | Antibacterial and antimicrobial activities. Antimicrofouling properties. | Iyapparaj et al. 2014 | |
| <i>Cymodocea nodosa</i> (Gran Canaria, Canary Islands; Cadiz and Alfacs bays, Spain; Zeytineli, Turkey; Sahline Sebkhah beach, Tunisia) | Phenolic acids: Chicoric acid / Caftaric acid. | Not Tested | Grignon-Dubois and Rezzonico 2013 | |
| <i>Cymodocea rotundata</i> <i>Cymodocea serrulata</i> (Chinnapallam, India) | Coumarins / Flavonoids / Phenols / Proteins / Free AminoAcids / Quinones / Saponins / Sterols / Sugars / Terpenoids. | Antibacterial, cytotoxic and haemolytic activities. | Ragupathi Raja Kannan et al. 2013a | |
| <i>Cymodocea rotundata</i> <i>Cymodocea serrulata</i> (Chinnapallam, India) | Phenol / Flavonoids / Tannin / Vitamin C / Vitamin E. Characterized Phenolic compound = <i>p</i> -coumaric acid | Antioxidant activity. | Ragupathi Raja Kannan et al. 2013b | |
| <i>Cymodocea rotundata</i> (Coast of Tuticorin, India) | Tannins / Saponins / Resins / Proteins / Acidic Compounds / Reducing Sugar / Terpenoids / Cardiac Glycoside / Alkaloids. | Antibacterial activity. | Mani et al. 2012 | |
| <i>Cymodocea serrulata</i> (Coast of Thondi, India) | Alkaloids / Flavonoids / Phenols / Steroids / Tannins. | Antibacterial activity. | Ravikumar et al. 2011 | |
| <i>Cymodocea nodosa</i> (Porto Germeno, Greece) | Deoxycymodienol / Isocymodiene / Meroterpenoid (nodosol) / Brominated briarane diterpene / Cymodienol. | Antibacterial activity. | Kontiza et al. 2008 | |
| <i>Cymodocea nodosa</i> (Ag. Cosmas Gulf, Greece) | Four 3-keto steroids: (20 <i>R</i>)-22 <i>E</i> -24-ethylcholesta-4,22-dien-3-one / (20 <i>R</i>)-24-ethylcholest-4-en-3-one / (20 <i>R</i>)-22 <i>E</i> -6 β -hydroxy-24-ethylcholesta-4,22-dien-3-one / 6 β -hydroxy-(20 <i>R</i>)-24-ethylcholest-4-en-3-one. | No data | Kontiza et al. 2006 | |
| <i>Cymodocea nodosa</i> (Ag. Cosmas Gulf, Greece) | Diarylheptanoids : Cymodienol / Cymodiene. | Cytotoxic activity against two lung cancer cell lines (NSCL-N6 and A549). | Kontiza et al. 2005 | |
| <i>Cymodocea serrulata</i> (Queensland, Australia) | 5 Sterols: Most abundant compounds = 24-ethylcholesta-5,22 <i>E</i> -dien-3 β -ol (stigmasterol) / 24-ethylcholest-5-en-3 β -ol (sitosterol). 28 Fatty acids: Most abundant compounds = Linolenic acid / Palmitic acid / Linoleic acid. | Not Tested | Gillan et al. 1984 | |
| <i>Cymodocea nodosa</i> (Bay of Naples, Italy) | Sterols: Most abundant compounds: Sitosterol / Cholesterol / Stigmasterol. | Not Tested | Sica et al. 1984 | |
| <i>Cymodocea nodosa</i> , <i>Cymodocea rotundata</i> , <i>Cymodocea serrulata</i> (Different origins) | Sulfated phenolic acids | Not Tested | McMillan et al. 1980 | |
| <i>Cymodocea rotundata</i> (Australia) <i>Cymodocea serrulata</i> (Kenya) | Phenolic acids: Caffeic / Protocatechuic / <i>p</i> -Coumaric / <i>p</i> -Hydroxybenzoic / Ferulic / Vanillic / Gentisic / Gallic. | Not Tested | Zapata and McMillan 1979 | |
| <i>Cymodocea nodosa</i> (Ganzirri, Sicily; Marsaxlokk, Malta) | 1- <i>chiro</i> -inositol / <i>myo</i> -inositol / <i>muco</i> -inositol. | Not Tested | Drew 1978 | |

(Macrophyte species are named as cited in the references)

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