## Table S1. Effect of organic solvents and cultivation parameters on microalgae growth and metabolism.

| Strain                | Solvent | Concentration | Exposure time | Effect on growth | Effect on metabolism | Ref. |
|-----------------------|---------|---------------|---------------|------------------|-----------------------|------|
| *Selenastrum capricornutum* | DMF     | 1.27-2.31 g/L (17.4-31.6 mM) | 96h | 50% inhibition | n.d. | [78] |
| *Selenastrum capricornutum* | DMF     | 0.094-0.94 g/L (0.01-0.1 v/v %) | 14 days | Slight stimulation observed | n.d. | [79] |
| *Pseudokirchneriella subcapitata* | Methanol | 82 g/L (2570 mM) | up to 2 h | 50% inhibition<sup>a</sup> | Decreased oxygen evolution rate | [73] |
| *Pseudokirchneriella subcapitata* | DMF     | 152.5 g/L (2089 mM) | 72h | 50% inhibition | n.d. | [47] |
| *Botryococcus braunii* | Methanol | ~23 g/L (3%) | 10 days | 100% stimulation | n.d. | [45] |
| *Chlamydomonas reinhardtii* | Methanol | 1.6 g/L (50 mM) | 6 days | 35% stimulation | Protein content- (30% increase)<sup>a</sup> Free amino acid content- (31% increase)<sup>a</sup> A change in amino acid composition<sup>b</sup> | [42] |
| *Chlorella minutissima* | Methanol | 3.96 g/L (0.5 v/v %) | 6 days | 45% stimulation<sup>a</sup> 27% inhibition<sup>a</sup> 74% inhibition<sup>b</sup> | n.d. | [40] |
| *Chlorella minutissima* | Methanol | 7.92 g/L (1 v/v %) | 45 days | 91% stimulation | 40% increase in lipid content | [41] |
| *Chlorella sorokiniana* | Methanol | 0.5 g/L (500 ppm) | 10 days | 69% increase | 160% increase in Chl a productivity | [43] |
| *Scenedesmus obliquus* | Methanol | 3.96 g/L (0.5 v/v %) | 120 h | 133% stimulation | 20% decrease in LHCII amount<sup>eb</sup> | [44] |
| *Arthrospira platensis* | Ethanol | 0.15-1.21 g/L | 8 days | 24% stimulation | n.d. | [55] |
| *Monodus subterraneus* | Ethanol | 7.89-15.78 g/L (1-2 v/v %) | 6 days | 13-44% inhibition | n.d. | [70] |
| *Scenedesmus obtusus* | Ethanol | 1.84 g/L | 9 days | 3-fold stimulation | n.d. | [56] |
| *Chlorella* | Ethanol | 1.38 g/L (0.03 M/L) | 24 days | 140% stimulation<sup>1</sup> 332% increase<sup>1</sup> | n.d. | [63] |
| *Spirulina platensis* | Ethanol | 16.56 g/L (0.36 M) | 8 days | 50% inhibition | 50% inhibition of oxygen evolution | [68] |
| Organism | Type of Alcohol | Concentration | Time | Effect | Chlorophyll a (increase) | Vitamin A (increase) | Vitamin E (increase) |
|----------|----------------|---------------|------|--------|-------------------------|---------------------|---------------------|
| Synechocystis sp. | Ethanol | 11.83 g/L (1.59 M) | 24h | 50 % inhibition | 100% increase | 105% increase | 105% increase |
| Synechocystis sp. | Ethanol | 11.83 g/L (1.59 M) | 24h | No effect | 54% | 54% | n.d. |
| Synechocystis sp. | Ethanol | 2 g/L | 20h | No effect | 40% | 48% | n.d. |
| Synechocystis sp. | Ethanol | 2 g/L | 20h | No effect | 91% | 90% | n.d. |
| Synechocystis sp. | Ethanol | 2 g/L | 20h | No effect | 40% | 48% | n.d. |
| Chlorella vulgaris | Ethanol | 3.94 g/L | 20h | 86% | 102% increase | 105% increase | 105% increase |
| Chlorella vulgaris | Methanol | 3.96 g/L | 20h | 69% | 7-fold increase | 39% increase | 62% increase |
| Chlorella vulgaris | DMSO | 5.5 g/L | 20h | No inhibition | 38% | 13% | 9% |
| Selenastrium capricornutum | Ethanol | 3.94 g/L | 4 days | 7% inhibition | 37% | 7% | n.d. |
| Selenastrium capricornutum | Methanol | 3.96 g/L | 4 days | 21% | 13% | 9% | n.d. |
| Selenastrium capricornutum | DMSO | 5.5 g/L | 4 days | 38% | 13% | 9% | n.d. |
| Selenastrium capricornutum | DMF | 4.72 g/L | 4 days | 38% | 13% | 9% | n.d. |
| Euglena gracilis | Ethanol | 4.6 g/L (100 mM) | 20 days | 200% stimulation | Chlorophyll (98% increase) | α-Tocopherol (7-fold decrease) | |
| Euglena gracilis | Ethanol | 10 g/L | 7 days | 57% Decrease | Vitamin A (105% increase) | Vitamin E (105% increase) | |
| Euglena gracilis | Ethanol | 10 g/L | 72h | 163% stimulation | α-Tocopherol (39% increase) | α-Tocopherol (62% increase) | |
| Euglena gracilis (wild) | Ethanol | 10 g/L | 72h | 142% stimulation | α-Tocopherol (62% increase) | α-Tocopherol (62% increase) | |
| Euglena gracilis (chloroplast-deficient) | Ethanol | 10 g/L | 72h | 142% stimulation | α-Tocopherol (62% increase) | α-Tocopherol (62% increase) | |
| Scenedesmus sp. | Ethanol | 1.42 g/L (0.18 v/v %) | 9 days | 50% stimulation | n.d. | 34 % increase in lipid content | |
| Scenedesmus sp. | Ethanol | 1.42 g/L (0.18 v/v %) | 10 days | 3-fold stimulation | 24% decrease in lipid content | 4-fold increase in respiratory rate | |
| Nannochloropsis sp. | Ethanol | 1.38 g/L (30 mM) | 7 or 8 days | 32% decrease (Het) | 3.4-fold increase in respiratory rate | Increase in C16:0, C18:0 | |
| Nannochloropsis sp. | Ethanol | 1.38 g/L (30 mM) | 7 or 8 days | 32% decrease (Het) | 3.4-fold increase in respiratory rate | Increase in C16:0, C18:0 | |

N.b. [69] [71] [46] [53] [54] [52] [57] [58] [59]
| Species                        | Alcohols, acetone, or aldehydes | Concentration  | Time  | Response       | Ref. |
|-------------------------------|---------------------------------|----------------|-------|----------------|------|
| *Chlorella kessleri*          | Ethanol                         | 2.3 g/L (50 mM) | 3 weeks | 2.5-fold stimulation Increase in C<sub>16:0</sub> Decrease in C<sub>16:1</sub>, C<sub>16:2</sub> | [60] |
| *Dunaliella tertiolecta*      | Methanol, ethanol, DMSO, DMF, acetone | Methanol: 23 g/L (23000 ppm) Ethanol: 16 g/L (16000 ppm) DMSO: 21 g/L (21000 ppm) DMF: 15 g/L (15000 ppm) Acetone: 10 g/L (10000 ppm) | 96h | 50% Inhibition | n.d. |
| *Isochrysis galbana*          | Methanol, ethanol, DMSO, DMF, acetone | Methanol: 21 g/L (21000 ppm) Ethanol: 15 g/L (15000 ppm) DMSO: 5 g/L (5000 ppm) DMF: 7 g/L (7000 ppm) Acetone: 4 g/L (4000 ppm) | 96h | 50% Inhibition | n.d. | [49] |
| *Heterosigma akashiwo*        | Methanol, ethanol, DMSO, DMF, acetone | Methanol: 0.5 g/L (500 ppm) Ethanol: 2.5 g/L (2500 ppm) DMSO: 7 g/L (7000 ppm) DMF: 7 g/L (7000 ppm) Acetone: 3 g/L (3000 ppm) | 96h | 50% Inhibition | n.d. |
| *Chlorella pyrenoidosa*       | Methanol, ethanol, DMSO, DMF, acetone | Acetone: 12 g/L (1.52 v/v %) Ethanol: 1.42 g/L (0.18 v/v %) DMSO: 16.39 (1.49 v/v %) DMF: 9.44 g/L (1 v/v %) | 96h | 50% Inhibition | n.d. | [48] |
| *Pseudokirchneriella subcapitata* | Acetone | Acetone: 6.4 g/L | 72h | 50% Inhibition | n.d. | [75] |
| *Pseudokirchneriella subcapitata* | Acetone | Acetone: 5.28 g/L | 48h | 50% Inhibition | n.d. | [74] |
| *Pseudokirchneriella subcapitata* | Acetaldehyde | Acetaldehyde: 0.017 mg/L | 48h | 50% Inhibition | n.d. | [74] |
| *Pseudokirchneriella subcapitata* | Butanone | Butanone: 8.6 g/L | 72h | 50% Inhibition | n.d. | [76] |
| *Pseudokirchneriella subcapitata* | Butanone | Butanone: 1.56 g/L | 72h | 50% Inhibition | n.d. | [75] |
| *Anabaena variabilis*         | Hexane, DMSO | Hexane: 43.75 g/L (6.58 v/v %) DMSO: 39.27 g/L (3.57 v/v %) | 10-14 days | 50% inhibition | n.d. | [80] |
| *Anabaena inaequalis*         | Hexane, DMSO | Hexane: 11.13 g/L (1.7 v/v %) DMSO: 18.8 g/L (1.71 v/v %) | 10-14 days | 50% inhibition | n.d. | [75] |
|                                | Octanol | Octanol: 2.1 mg/L | 72h | 50% Inhibition | n.d. | [75] |
| Species/Mixture | Solvent | Concentration | Time | Effect |
|----------------|---------|---------------|------|--------|
| *Pseudokirchneriella subcapitata* | Hexanol | 115 mg/L | | Inhibition |
| | Pentanol | 370 mg/L | | |
| | Butanol | 1561 mg/L | | |
| *Pseudokirchneriella subcapitata* | 1-propanol | 4.95 g/L | 48h | 50% Inhibition |
| | 2-propanol | 8.47 g/L | | |
| *Chlorella vulgaris* | Isopropanol (IPA) | 16 g/L | 360h | 47% inhibition IPA conversion to acetone |
| *Pseudokirchneriella subcapitata* | 1-butanol | 1.56 g/L | 72h | 50% Inhibition |
| | Iso-butanol | 1.69 g/L | | |
| *Chlorella vulgaris* | 1-propanol | 4.95 g/L | 48h | 50% Inhibition |
| | 2-propanol | 8.47 g/L | | |
| *Glycols* | EG | 10.9 g/L | 96h | 50% Inhibition |
| | PG | 20.6 g/L | | |
| *Pseudokirchneriella subcapitata* | EG | 36.6 g/L | 72h | 50% Inhibition |
| | EGBE | 1.84 g/L | | |
| *Pseudokirchneriella subcapitata* | EGBE | 1.84 g/L | 72h | 50% Inhibition |
| *Chlorella protothecoides* | EG | 2.59 g/L | 10 days | Growth confirmed Acidification of medium |
| | PG | 2.1 g/L | | |
| *Cyclic solvents* | Furanidine (THF) | 2.57 g/L (0.29 v/v %) | 96h | 50% Inhibition |
| *Microcystis aeruginosa* | Dioxane | 5.6 g/L | 8 days | Toxicity threshold |
| *Pseudokirchneriella subcapitata* | Cyclohexane | 19.3 mg/L | 72h | 50% Inhibition |
| | Cyclohexanol | 411 mg/L | | |
| | Cyclohexanone | 1.16 g/L | | |
| *Chlorella pyrenoidosa* | 1,558 g/L (0.2 v/v %) | 10 days | | Full growth inhibition |
| | Cyclohexane | 25 days | | 100-150% stimulation |
| *Chlorella vulgaris* | DCM | 13.3 mg/L | 72h | 50% Inhibition |
| *Selenastrum capricornutum* | DCM | 2 µg/L-2 mg/L | 8 days | No effect on growth |
| | Trichloroethylene | 3 µg/L-3 mg/L | | |
| *Volvulina steinii* | DCM | 2 µg/L-2 mg/L | | 100% inhibition and cell death |
| | Trichloroethylene | 3 µg/L-3 mg/L | | |
| *Raphidocelis subcapitata* | Trichloroethylene (glass enclosure assay) | 0.55 g/L | 72h | 50% inhibition |
| | | 0.1 g/L | 72h | 23% stimulation |
| | Trichloroethylene (plate assay) | 0.45 g/L | 144h | 50% inhibition |
| | | 0.05 g/L | 144h | 72% stimulation |
| *Desmodesmus subspicatus* | Trichloroethylene (glass enclosure assay) | 0.3 g/L | 72h | 50% inhibition |
| | Trichloroethylene (plate assay) | 0.35 g/L | 72h | 50% inhibition |
| *Chlorella kessleri* | Trichloroethylene (glass enclosure assay) | 0.5 g/L | 24h | 50% inhibition |
| | Trichloroethylene (plate assay) | 0.2 g/L | 24h | 50% inhibition |
| Species                  | Solvent           | Concentration | Time  | Inhibition | Comments                                      |
|-------------------------|-------------------|---------------|-------|------------|-----------------------------------------------|
| *Chlamydomonas reinhardtii* | Trichloroethylene | 36.5 mg/L     | 72h   | 50%        | n.d. [90]                                     |
|                         | Tetrachloroethylene | 3.64 mg/L    |       |            |                                               |
| *Synechococcus elongatus* | Trichloroethylene | 1.357 g/L     |       | 36%        | increase in lipid peroxidation and activity of SOD and Peroxidase [91] |
|                         | Tetrachloroethylene | 0.149 g/L    | 24h   | 50%        |                                               |
|                         | Tetrachloroethane  | 2.86 g/L      |       | 59%        | Decrease in Chl content/cell                   |
| *Chlamydomonas reinhardtii* | Tetra-chloromethane | 0.246 mg/L   | 72h   | 50%        | n.d. [90]                                     |
| *Pseudokirchneriella subcapitata* | Chloroform | 233 mg/L      | 72h   | 50%        | n.d. [75]                                     |
|                         | Tetra-chloromethane | 10.7 mg/L    |       |            |                                               |
| *Pseudokirchneriella subcapitata* | trans-1,2- | 36.4 mg/L     | 48h   | 50%        | n.d. [74]                                     |
|                         | dichloroethylene  |               |       |            |                                               |
|                         | cis-1,2- | 59.7 mg/L     |       |            |                                               |
|                         | dichloroethylene  |               |       |            |                                               |
| **Aromatic solvents**   |                   |               |       |            |                                               |
| *Amphidinium carterae*   | Benzene           | 0.1-10 mg/L   | 2nd or 3rd day of logarithmic growth | 35% inhibition | n.d.                                           |
|                         | Toluene           |               |       | 30%        |                                               |
|                         | Xylene            |               |       | 15%        |                                               |
| *Skeletonema costatum*   | Benzene           | 0.1-10 mg/L   | 2nd or 3rd day of logarithmic growth | No effect | n.d. [96]                                     |
|                         | Toluene           |               |       | No effect  |                                               |
|                         | Xylene            |               |       | 25%-0%     | inhibition                                     |
| *Dunaliella tertiolecta* | Benzene           | 0.1-10 mg/L   | 2nd or 3rd day of logarithmic growth | 10% stimulation | n.d.                                           |
|                         | Xylene            |               |       | 20%        | stimulation to 10% inhibition                 |
| *Cricosphaera carterae*  | Benzene           | 0.1-10 mg/L   | 2nd or 3rd day of logarithmic growth | No effect | n.d.                                           |
|                         | Toluene           |               |       | 35%        | stimulation                                  |
|                         | Xylene            |               |       | 20%        |                                               |
| *Pseudokirchneriella subcapitata* | Benzene | 15.7 mg/L     | 48h   | 50%        | Inhibition                                    |
|                         | Toluene           | 14.2 mg/L     |       | n.d.       |                                               |
|                         | Nitrobenzene      | 13.9 mg/L     |       |            |                                               |
| *Pseudokirchneriella subcapitata* | Benzene | 124 mg/L      | 72h   | 50%        | Inhibition                                    |
|                         | Toluene           | 25.5 mg/L     |       | n.d.       |                                               |
|                         | Xylene            | 8-26 mg/L     |       |            |                                               |
| *Selenastrum capricornutum* | BTEX            | 22.7 mg/L     | 8 days | 50%        | possible damage to membrane integrity [101] |
|                         | (52% benzene, 28% toluene, 5% ethylbenzene, 5% of o-, m- and p-xylene) | | | | |
| *Scenedesmus obliquus*   | m-Cresol          | 1.5 mM (CO₂)  | 5 days | No effect  |                                               |
|                         |                  | 1.5 mM (glc)  |      |            |                                               |
|                         |                  | 1.5 mM (CO₂+glc) | 1.5 mM | 0.162 g/L (1.5 mM) | 5 days | 81% stimulation | No stress effect on photosynthetic apparatus observed [109] |
|                         |                  | (limCO₂)      |      |            |                                               |
| *Ochromonas danica*     | p-Cresol          | 0.054-0.432 g/L (0.5-4 mM) | up to 12 days | Growth supported in the dark | n.d. [107] |
|                         |                  | 0.016 g/L     | 5 days | 20%        | No stress effect on photosynthetic apparatus [108] |
|                         |                  | (0.15 mM)     | 1 day  | No effect  |                                               |
| Strain                   | ILs                        | Conc.     | Exposure time | Effect on growth | Effect on metabolism                             | Ref. |
|-------------------------|----------------------------|-----------|---------------|------------------|--------------------------------------------------|------|
| *Pseudokirchneriella subcapitata* | [C3MIM]Br, [C3MPy]Br       | >205 g/L (>1000 mM) | up to 2 h     | 50% inhibition   | Decreased oxygen evolution rate                   | [110]|
|                         | [C3MIM]Br, [C3MPy]Br       | 11.59 g/L (53.7 mM)  |               |                  |                                                  |      |
| *Scenedesmus rubescens*  | [C4MIM]BF4, [C8MIM]BF4     | >200 mg/L | 24 h          | 50% inhibition   |                                                  | [114]|
|                         | [C4MIM]BF4, [C8MIM]BF4     | >200 mg/L | 72h           |                  |                                                  |      |
|                         | [C4MIM]BF4, [C8MIM]BF4     | 2.97 mg/L | 24h           |                  | 50% inhibition                                    | n.d. |
| Organism/Species | Ionic Liquid | Concentration (mg/L) | Time (h) | 50% Inhibition | References |
|------------------|--------------|----------------------|---------|----------------|-----------|
| Scenedesmus obliquus | [C4MIM]Br | 0.31 | 72h |  | [115] |
| | | 40 | 24h |  |  |
| | | 24.1 | 48h |  |  |
| | | 23.6 | 72h |  |  |
| | | 22.2 | 96h |  |  |
| | [C4MIM]Br | 17.67 | 24h | 50% |  |
| | | 14.7 | 48h |  |  |
| | | 8.63 | 72h |  |  |
| | | 5.88 | 96h | n.d. |  |
| | [C6MIM]Br | 24.1 | 48h |  |  |
| | | 23.6 | 72h |  |  |
| | | 22.2 | 96h |  |  |
| | [C4MIM]Br | 26.95 | 24h | 50% |  |
| | | 24.2 | 48h |  |  |
| | | 10.83 | 72h |  |  |
| | | 5.88 | 96h | n.d. |  |
| | [C6MIM]Br | 17.67 | 24h |  |  |
| | | 14.7 | 48h |  |  |
| | | 8.63 | 72h |  |  |
| | | 5.88 | 96h | n.d. |  |
| | [C4MPy]Br | 1.127 | 96h | 50% |  |
| | | 5.72 | n.d. |  |  |
| | | 2.73 | n.d. |  |  |
| | | 13.3 | n.d. |  |  |
| | [C4MPyrr]Br | 1.127 | 96h | 50% |  |
| | | 5.72 | n.d. |  |  |
| | | 2.73 | n.d. |  |  |
| | | 13.3 | n.d. |  |  |
| | [C4Py]Tf2N | 7.05 | 72h | 50% |  |
| | | >100 | 72h |  |  |
| | | 26.5 | 72h |  |  |
| | [C4MPyr]Tf2N | 353 | 72h | 50% |  |
| | | 17.2 | 72h |  |  |
| | | 0.084 | 72h |  |  |
| | [C4MIM]Br | 0.466 | 96h | 50% |  |
| | | 0.5 | n.d. |  |  |
| | | 0.567 | n.d. |  |  |
| | | 0.372 | n.d. |  |  |
| | | 0.05 | n.d. |  |  |
| | [C4MIM]Cl | 1.36 | 48h | 50% |  |
| | | 0.027 | 48h |  |  |
| | | 0.012 | 48h |  |  |
| | [C4MIM]BF4 | 38.5 | 48h | 50% |  |
| | | 1.1 | n.d. |  |  |
| | | 4.1 | n.d. |  |  |
| | | 12.9 | n.d. |  |  |
| | [C4MIM]PF6 | 17.46 | 15 days | ~50% |  |
| | | 0.1 | n.d. |  |  |
| | [C4MIM]SbF6 | 0.466 | 96h | 50% |  |
| | | 0.5 | n.d. |  |  |
| | | 0.567 | n.d. |  |  |
| | | 0.372 | n.d. |  |  |
| | | 0.05 | n.d. |  |  |
| | [C4MIM]BF4 | 100 | 24h | 16% |  |
| | | 48% | 24h |  |  |
| | [C4MIM]BF4 | 100 | 24h | 58% |  |
| | Dunaliella tertiolecta | 100 | 24h | 58% |  |

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*Inhibition of esterase activity.*
*Damage to cell wall and membranes.*
*Damaged structures of chloroplasts, thylakoids and mitochondria.*
*Increased deposits in vacuoles.*
*Chlorophyll increase (500%).*
| Organism                  | Ionic Liquid | Concentration | Effect Time | % Inhibition | Effect Description                                                                 | Reference |
|--------------------------|--------------|---------------|-------------|--------------|----------------------------------------------------------------------------------|-----------|
| Skeletonema marinoi      | [C₄MIM]Cl    | 21 mg/L       | 72h         | 50%          | Chlorophyll increase (466%)                                                        | [128]     |
|                          |              |               |             |              | Carotenoid increase (225%)                                                        |           |
|                          |              |               |             |              | Chlorophyll increase (233%)                                                        |           |
| Phaeodactylum tricornutum| [C₄MIM]Cl    | (220 mg/L)    | 72h         | 50%          | Interference in silica uptake and cell wall organization [1.3-3.4]                 |           |
|                          |              | 1.26 mM       |             |              |                                                                                  |           |
|                          |              |               |             |              | Increase in soluble protein content (136%)                                        | [130]     |
|                          |              |               |             |              | Increase in POD activity (110%), SOD activity (33%) and CAT activity (75%)        |           |
|                          |              |               |             |              | Increase in MDA content (145%)                                                    |           |
| Synechococcus sp.        | [HOC₂MIM]Cl  | 120 mg/L      | 96h         |              | No effect on growth                                                                | [131]     |
|                          |              |               |             |              | No change in Chl a content                                                          |           |
|                          |              |               |             |              | Increase in soluble protein content (60%)                                         |           |
|                          |              |               |             |              | Increase in SOD activity (44%)                                                     |           |
|                          |              |               |             |              | Increase in MDA content (60%)                                                     |           |
| Phaeodactylum tricornutum| [C₈MIM]Br    | 8.9 mg/L      | 96h         | 50%          | Decrease in Chl a content (43.8%)                                                 | [132]     |
|                          |              |               |             |              | Increase in soluble protein content (100%)                                        |           |
|                          |              |               |             |              | Increase in SOD activity (84%)                                                    |           |
|                          |              |               |             |              | Increase in ROS level (316%) and MDA content (163%)                               |           |
| Skeletonema costatum     | [C₈MIM]Br    | 40 mg/L       | 96h         | 50%          | Increase in ROS production (22%)                                                  | [122]     |
|                          |              |               |             |              | Increase in ROS production (233%)                                                 |           |
|                          |              |               |             |              | Increase in protein content (22%)                                                 |           |
|                          | [MOC₂MPyr]NTf₂| (0.55 g/L)    | 72h         | 50%          | n.d.                                                                              |           |
|                          |              | 1.3 mM        |             |              | Increase in protein content (32%)                                                 |           |
|                          |              | (0.36 g/L)    |             | Limited      |                                                                                    |           |
|                          |              | 0.9 mM        |             | inhibition   |                                                                                    |           |
| Raphidocelis subcapitata | [MOC₂MPyr]BF₄| (0.55 g/L)    | 72h         | 50%          | n.d.                                                                              |           |
|                          |              | 2.4 mM        |             | Limited      |                                                                                    |           |
|                          |              | (0.39 g/L)    |             | inhibition   |                                                                                    |           |
|                          |              | 1.7 mM        |             |              |                                                                                    |           |
| Scenedesmus obliquus     | L-(+)[C₄MIM]L| >1 g/L        | 24h         | 50%          | Increase in ROS production (22%)                                                  | [123]     |
|                          |              | (>5 mM)       |             |              | Increase in ROS production (233%)                                                 |           |
|                          | D-(−)[C₄MIM]L| 0.45 g/L      |             | 50%          | n.d.                                                                              |           |
|                          |              | (2.25 mM)     |             |              |                                                                                    |           |
| Euglena gracilis         | L-(+)[C₄MIM]L| 1.31 g/L      | 24h         | 50%          | Increase in CMP (530%)                                                             |           |
|                          |              | (6.58 mM)     |             |              | Increase in CMP (150%)                                                             |           |
|                          | D-(−)[C₄MIM]L| 1.25 g/L      |             |              |                                                                                    |           |
|                          |              | (6.24 mM)     |             |              |                                                                                    |           |
| Scenedesmus obliquus     | L-(+)[H₄MIM]T| 16 mg/L       | 24h         | 50%          | Increase in CMP (479%)                                                             | [124]     |
|                          |              | 7.9 mg/L      |             |              | Increase in CMP (120%)                                                             |           |
|                          | D-(−)[H₄MIM]T| 28.3 mg/L     |             | 50%          |                                                                                    |           |
|                          |              | 12.2 mg/L     |             |              |                                                                                    |           |
|                          | [OHC₂MIM]Cl  | >0.254 g/L    |             |              |                                                                                    |           |
|                          |              | (>1 mM)       |             |              |                                                                                    |           |
| Species                     | Compound                  | Concentration (µg/L) | Concentration (µM) | Exposure Time | Inhibition | Reference |
|-----------------------------|---------------------------|----------------------|--------------------|--------------|------------|-----------|
| *Scenedesmus vacuolatus*    | [OHC-MIM]NTf₂             | 61                    | 150                | 24h          | 50%        | [120]     |
|                            | [C-MIM]Cl                 | 88.2                  | 602                |
|                            | [C-MIM]Cl                 | 0.46                  | 0.002              |
|                            | [C₈-MIM]Cl                | 0.077                 | 0.3 nM             |
|                            | [MP-bBIM]Br               | 10.33                 | 0.035              |
|                            | [C₂O-bBIM]Br              | 13.66                 | 0.042              |
|                            | [C₆-bBIM]Br               | 0.513                 | 1.66               |
|                            | [C₆-bBIM]I                | 0.345                 | 0.97               |
|                            |                           | 50% inhibition        | n.d.               |
| *Chlorella vulgaris*        | [MDP-b(Py)AcOM]Br         | 441                   |                    |
|                            | [MDP-b(PyAcO)AcOM]Br      | 294                   |                    |
| *Pseudokirchneriella subcapitata* | [MDP-b(Py)AcOM]Br         | 587                   |                    |
|                            | [MDP-b(PyAcO)AcOM]Br      | 281                   |                    |
| *Raphidocelis subcapitata*  | [Chol]Bic                 | 252                   |                    |
|                            | [Chol]Bit                 | 27                    |                    |
|                            | [Chol]DHCit               | 87                    |                    |
|                            | [Chol]Cl                  | 72                    |                    |
|                            | [Bzchol]Cl                | 196                   |                    |
|                            |                           | 50% inhibition        | n.d.               |

**CMP** – cell membrane permeability

NTf₂=N(CF₃SO₂)₂
S3. Calculation scheme

1. Calculation Procedure

Fundamental energy requirements and production cost were analysed for isolation of demanded product. The analyses were carried out in simplified form under following assumptions: 1) total solvent recovery, 2) no heat losses, 3) no heat recovery and 4) equipment amortization is not taken into account.

**Figure S1.** Scheme of Calculation Procedure.

Figure S1. shows a model for the calculation procedure. All lab-scale technologies are composed of these technological steps - pretreatment, extraction and solvent recovery including its recycling. The specific energy requirement $E_{SEP}$ (J kg$^{-1}$) and the specific production cost $C_{SEP}$ (€ kg$^{-1}$) of separation process used were calculated as follows:

$$E_{SEP} = \frac{E_{TOTAL}}{m_{PRODUCT}}$$  \hspace{1cm} (1)

$$C_{SEP} = \frac{C_{TOTAL}}{m_{PRODUCT}}$$  \hspace{1cm} (2)

where $E_{TOTAL}$ is total energy requirement of separation process (J), $C_{TOTAL}$ is total costs for product separation (€) and $m_{PRODUCT}$ is weight of the product (kg) defined as

$$m_{product} = w_{dB} \cdot m_{wB} \cdot y_{product}$$  \hspace{1cm} (3)

where $m_{wB}$ is the mass of wet biomass (kg), $w_{dB}$ is mass fraction of dried biomass (-) and $y_{product}$ is the yield of product related to dried biomass (-).

The total energy demand of extraction using liquid solvent was calculated:

$$E_{TOTAL} = E_{PT} + E_{EM} + E_{SSP} + E_{SC}$$  \hspace{1cm} (4)

where $E_{PT}$ is the energy needed for pretreatment (J), $E_{EM}$ is the energy needed for mixing during extraction (J), $E_{SSP}$ is the energy needed for solvent separation from an extract (J) and $E_{SC}$ is the energy needed for reverse solvent condensation (J).

The energy requirement needed for pretreatment $E_{PT}$ was calculated:

$$E_{PT} = P_{PT} \cdot t_{PT} = \varepsilon_{PT} \cdot V_{PT} \cdot t_{PT}$$  \hspace{1cm} (5)
where $P_{PT}$ is the power input of equipment used for pretreatment (W), $V_{PT}$ is the volume of pretreated mixture (m$^3$), $t_{PT}$ is the time of pretreatment (s) and $\varepsilon_{PT}$ is the specific power requirement of pretreatment (W m$^{-3}$).

The energy requirement needed for mixing during extraction was calculated:

$$E_{EM} = \varepsilon_{EM} \cdot V_{EM} \cdot t_{EM}$$

(6)

where $\varepsilon_{EM}$ is the specific power input for mixing (W m$^{-3}$), $V_{EM}$ is the volume of mixture during extraction (m$^3$), $t_{EM}$ is the time of mixing during extraction (s). The specific power input for mixing $\varepsilon_{EM} = 300$ W m$^{-3}$ was assumed for calculation.

Assuming that the multi-component solvent is totally separated from an extract by the evaporation the energy needed for separation was calculated in simplified form as follows:

$$E_{SSP} = \sum_j \Delta H_{j}^{vap}(T) \cdot m_{S-j}$$

(7)

where $\Delta H_{j}^{vap}(T)$ is the heat of vaporization of $j$th component of the solvent solution (J kg$^{-1}$) at temperature $T$ (K) and $m_{S-j}$ is the mass of $j$th component of the solvent solution (kg). The heat of vaporization was calculated using following formula:

$$\Delta H_{j}^{vap}(T) = A \cdot \exp(-\alpha \cdot T_r) \cdot (1 - T_r)^\beta$$

(8)

where $A$, $\alpha$ and $\beta$ are parameters overtaken from NIST database for given component, $T_r$ is reduced temperature calculated as ratio of temperature $T$ and critical temperature $T_c$ of given component. The evaporation at normal pressure was assumed. The heats of vaporization were calculated at normal boiling temperature for given component. Assuming that the reverse condensation of solvent components occurs at the same conditions as evaporation the energy needed for condensation $E_{SC}$ equals to $E_{SSP}$.

The total cost for extraction process was calculated:

$$C_{TOTAL} = C_{CH} + C_{PT} + C_{EM} + C_{SSP} + C_{SC}$$

(9)

where $C_{CH}$ is the cost of chemicals (€), $C_{PT}$ is the price of electricity required for pretreatment (€), $C_{EM}$ is the price of electricity required for mixing during extraction (€), $C_{SSP}$ is the price of water steam needed for solvent evaporation (€) and $C_{SC}$ is the price of cooling water needed for reverse solvent condensation (€).

The prices of electricity needed for pretreatment and for mixing during extraction were calculated as follows:

$$C_{PT} = c_{el} \cdot E_{PT}$$

(10)

$$C_{EM} = c_{el} \cdot E_{EM}$$

(11)

where $c_{el}$ is the price of electricity (€ MJ$^{-1}$).

The condensation of saturated water steam was assumed as an energy source for solvent evaporation. The price of water steam needed was calculated:

$$C_{SSP} = c_{steam} \cdot \left( \frac{E_{SSP}}{\Delta H_{steam}^{cond}} \right)$$

(12)

where $c_{steam}$ is the price of water steam (€ kg$^{-1}$) and $\Delta H_{steam}^{cond}(T_{cond}$) is the heat of condensation of water steam at condensation temperature $T_{cond}$. The saturated water steam at temperature of 150°C was assumed for solvent evaporation.

The price of cooling water needed for solvent condensation was calculated:
The costs of the chemicals were estimated on the basis of the following prices: 1) chloroform p.a.: 5 750 € m⁻³, 2) hexane p.a.: 20 500 € m⁻³, 3) dichloromethane p.a.: 6 800 € m⁻³, 4) methanol p.a.: 2 300 € m⁻³, 5) acetone p.a.: 2 900 € m⁻³, 6) ethyl acetate p.a.: 93 000 € m⁻³, 7) ionic liquid THPC: 271 000 € m⁻³, 8) ionic liquid [BMIM]HSO₄: 590 500 € m⁻³, 9) ionic liquid EMIM DBP: 135 000 € m⁻³, 10) water: 4 € m⁻³, 11) CO₂ (food quality): 1.8 € kg⁻¹ and 12) ethanol absolute: 28.5 € kg⁻¹.

The energy costs were estimated on the basis of the actual mean prices: 1) electricity: 126 000 € MJ⁻¹, 2) saturated water steam: 20 € t⁻¹, 3) cooling water: 0.1 € t⁻¹.

The error of presented estimations is 20 % in maximum for both energy requirement and production costs.

2. Supercritical Extraction Technology

The supercritical extraction was calculated under following assumptions: 1) two-stage solvent compression with inter- and after cooling of compressed solvent, 2) reversible adiabatic compression, 3) adiabatic efficiency of 60 % for irreversible compression, 4) mechanical efficiency of 96 % of driving unit, 5) inlet temperature of 20°C and pressure of 101.325 kPa of the solvent before first-stage compression, 6) outlet solvent temperature from coolers equals to extraction temperature reported in the cited article and 7) Poisson constant κ = 1.29.

The total energy requirement of supercritical extraction was calculated as

\[ E_{total} = E_C + E_{GSC} \]  \hspace{1cm} (14)

where \( E_C \) is the energy needed for solvent compression (J) and \( E_{GSC} \) is the energy needed for cooling of compressed solvent cooling after compression (J).

The energy needed for solvent compression in \( i \)th compression stage was calculated as follows:

\[ E_{Ci} = n_{solvent} \cdot \left(1/\eta_{ad}\right) \cdot \left(1/\eta_{m}\right) \cdot w_{t-rev} \]  \hspace{1cm} (15)

where

\[ w_{t-rev} = \left(\kappa/(1-\kappa)\right) \cdot p_{in} \cdot v_{in} \cdot \left[\left(p_{in} / p_{out}\right)^{(1-\kappa)/\kappa} - 1\right] \]  \hspace{1cm} (16)

where \( n_{solvent} \) is the number of moles of compressed solvent (mol), \( p_{in} \) is the stage inlet pressure (Pa), \( p_{out} \) is the stage outlet pressure (Pa), \( v_{in} \) is molar volume of the solvent in the stage inlet (m³ mol⁻¹), \( \eta_{ad} \) is the adiabatic efficiency of irreversible compression (-), \( \eta_{m} \) is the efficiency of the driving unit (-), \( w_{t-rev} \) is the shaft work of reversible compression (J mol⁻¹) in the stage and \( \kappa \) is the Poisson constant (-).

The pressure between compression stages was estimated using formula:

\[ p_{12} = (p_{in-1} \cdot p_{out-2})^{1/2} \]  \hspace{1cm} (17)

where \( p_{in-1} \) is the inlet pressure to the compressor, \( p_{out-2} \) is the outlet pressure from the compressor.

The energy needed for cooling of compressed solvent after \( i \)th compression stage was calculated as follows:
\[ E_{GSCi} = n_{solvent} \cdot \sum_j x_j \cdot (-\Delta h_j^{cooling}) \]  \hspace{1cm} (18)

where

\[ \Delta h_j^{cooling} = \int_{T_{in-c}}^{T_{out-c}} c_{pj}(T) \cdot dT \]  \hspace{1cm} (19)

where \( x_j \) is the mole fraction of the \( j \)-th solvent component (-), \( \Delta h_j^{cooling} \) is the enthalpy change of the \( j \)-th solvent component during solvent cooling (J mol\(^{-1}\)), \( T_{in-c} \) and \( T_{out-c} \) are the temperatures at inlet and outlet of the cooler of the \( i \)-th compression stage (K) and \( c_{pj}(T) \) is the temperature dependence of the molar heat capacity of the \( j \)-th solvent component (J mol\(^{-1}\)K\(^{-1}\)).

The inlet temperature to the cooler \( T_{in-c} \) was calculated from the following relation:

\[ w_{t-irrev} = w_{t-rev} \cdot (1 / \eta_{ad}) = \frac{c_p \cdot (T_{in-c} - T_{in})}{\eta} \]  \hspace{1cm} (20)

where \( T_{in} \) is the solvent temperature at stage inlet (K), \( c_p \) is the average molar heat capacity of the solvent in the given temperature range (J mol\(^{-1}\)K\(^{-1}\)). It was found that gas behavior in stage output is close to ideal gas behavior. Therefore, the molar heat capacity for ideal gas was used for calculation in this case.

The total cost for supercritical extraction was calculated:

\[ C_{total} = C_C + C_{GSC} \]  \hspace{1cm} (21)

where \( C_C \) is the price of electricity needed for solvent compression (€) and \( C_{GSC} \) is the price of cooling water needed for cooling of compressed solvent after compression (€).

The price of electricity needed for compression was calculated as follows:

\[ C_C = c_{el} \cdot E_C \]  \hspace{1cm} (22)

where \( c_{el} \) is the price of electricity (€ MJ\(^{-1}\)). The price of cooling water needed for cooling of compressed solvent after compression was calculated:

\[ C_{GSC} = c_{cw} \cdot (E_{GSC} / (c_{pcw} \cdot \Delta T_{cw})) \]  \hspace{1cm} (23)

where \( c_{cw} \) is the price of cooling water (€ kg\(^{-1}\)), \( c_{pcw} \) is the specific heat capacity of cooling water (J mol\(^{-1}\)K\(^{-1}\)) and \( \Delta T_{cw} \) is allowed temperature increase of cooling water. The allowed temperature increase of 15 K and specific heat capacity of cooling water of 4182 (J mol\(^{-1}\)K\(^{-1}\)) were assumed and used for calculation.