**Table S1.** Comparison of different studies using enclosed biofilm bioreactors with different materials as microalgal biofilm carriers.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Microalgae strain** | **Type of reactor** | **Carrier material** | **Type of carrier** | **Growth medium** | | **Operational condition** | **Biomass Product. (g m-2 d-1)** | **Temp. (°C)** | **Time (d)** | **References** |
| *Scenedesmus vacuolatus* ACUF\_053  *Chlorella vulgaris* ACUF\_809 | Stationary biofilm PBR design | Cotton carrier | Synthetic | | Modified BBM | Semi-batch | **-** | 25 ± 3 | 40 | Moreno Osorio et al., 2019b |
| *Chlorella. vulgaris* (CCAP 211/11B) | 12-well microtite plates on orbital shaker) | Poly methylmethacrylate (PPMA) | Synthetic | | OECD test medium  synthetic medium simulating a domestic effluent | Batch | - | 24 ± 1 | 7 | Barros et al., 2018 |
| *Pseudokirchneriella subcapitata* (CCAP 278/4) | Stainless steel AISI316 (SS) |
| *Synechocystis aureginosa (LEGE 91344)* | Polyvinyl chloride (PVC) |
| *Microcystis aeruginosa* LEGE 91344 | Polystyrene (PS) |
|  | Copper (Cu) |
| *Scenedesmus. obliquus* (FACHB-417) | Micro-photo-bioreactor with grooves at the botton /side (B-MPBR and S-MPBR) | Polydeimethyl-siloxane (PDMS) | Synthetic | | BG 11 | Batch | 15.83 ± 0.09 | 25 | 18 | Huang et al., 2018 |
| *Scenedesmus obliquus* (FACHB-416) | Flat plate algal biofilm photobioreactor (FPBR) | Pine sawdust (PW) | Natural | | BG-11 | Pilot - semibatch | PW 10.92 | 25 ± 2 | 16 - 20 | Zhang et al., 2017 |
| *Chlorella vulgaris* (FACHB-329 | Rice husk (RH) |  | RH 7.32 |
| *Oscillatoria tenuis* (FACHB-1052) | Oak Sawdust (OW) |  | OW 8.07 |
|  | Sugarcane bagase (SB) |  | SB 9.54 |
|  | Polymethyl-methacrylate (PMM) |  | PMM 4.01 |
| *Scenedesmus obliquus* (FACH 417) | Glass + polytetrafluoroethylene (PTFE) | Polymetyl-methacrylate PBR | Synthetic | | BG-11 | Batch | no treated PTFE 2.4 | 26 ± 1 | 7 | Zheng et al., 2017 |
| PTFE 1% 4 |
| PTFE 5% 1.7 |
| *Chlorella pyrenoidosa* | Glass chamber- algal disk | Filter paper | Natural | | Swine wastewater  BG-11, control | Semibatch | 5.03 | 26± 2 | 8 | Cheng et al. 2017 |
| *Scenedesmus* LX 1 (GMCC 3036) | Suspended solid ohase photobioreactor (ssPBR) | Pre coated Cotton duct with ambient bacteria | Natural | | mBG-11 | Continuous | - | 35 | 13 | Zhuang et al., 2016 |
| Consortium contained:  *Pseudanabaena* sp., | RABR | Braid cotton cords | Natural | | Dairy manure wastewater | Batch | 5.1 - 8.7 | 7 | 7 | Fica and Sims, 2016 |
| *Oscillatoria* sp., | 17 |
| *Chroococcus* sp. | 27 |
| *Chlorella. vulgaris* (UTEX #265) + cyanobacteria | Revolving algal biofilm (RAB) system | Brass | Synthetic | | BBM | stationay and roky batch | PP 0.05 (mm mesh size openings) 2 ± 0.5 | 20 - 25 | 7- 35 | Gross et al. 2016 |
|  | Stainless steel |  | |  | PP 0.5 (mm) 4.1 ± 0.51 |  |  |
|  | Acrylonitrile butadiene styrene (ABS) |  | |  | PP 1.25 (mm) 3.8 ± 1 |  |  |
|  | Nylon (N) |  | |  | PP 2.5 (mm) 2.5 ± 1.5 |  |  |
|  | Polyethylene terephthalate (PETG) |  | |  | Nylon 0.05 (mm) 2.3 ± 0.7 |  |  |
|  | Chlorinated polyvinyl chloride (CPVC) |  | |  | Nylon 0.5 (mm) 4.4 ± 0.5 |  |  |
|  | Delrin acetal resin |  | |  | Nylon 1.25 (mm) 4.3 ± 0.7 |  |  |
|  | Polyester |  | |  | Nylon 2.5 (mm) 2.6 ± 0.8 |  |  |
|  | Polylactic acid (PLA) |  | |  | CD 2.4 ± 0.1 |  |  |
|  | Polycarbonate |  | |  |  |  |  |
|  | Extruded acrylic |  | |  |  |  |  |
|  | Extruded nylon |  | |  |  |  |  |
|  | High-density polyethylene |  | |  |  |  |  |
|  | Polypropylene (PP) |  | |  |  |  |  |
|  | Polystyrene |  | |  |  |  |  |
|  | Low density polyethylene (LDPE) |  | |  |  |  |  |
|  | Polyvinyl chloride (PVC) |  | |  |  |  |  |
|  | Rexolite polystyrene |  | |  |  |  |  |
|  | Ultra-high-molecular-weight polyethylene |  | |  |  |  |  |
|  | Buna-N rubber |  | |  |  |  |  |
|  | Neoprene rubber |  | |  |  |  |  |
|  | NORYL PPO |  | |  |  |  |  |
|  | Gum rubber |  | |  |  |  |  |
|  | Butyl rubber |  | |  |  |  |  |
|  | Ethylene propylene diene monomer (EPDM) |  | |  |  |  |  |
|  | Epichlorohydrin (ECH) rubber |  | |  |  |  |  |
|  | Hypalon rubber |  | |  |  |  |  |
|  | Latex rubber |  | |  |  |  |  |
|  | Polyurethane |  | |  |  |  |  |
|  | Santoprene rubber |  | |  |  |  |  |
|  | Styrene-butadiene (SBR) rubber |  | |  |  |  |  |
|  | Silicone rubber |  | |  |  |  |  |
|  | Cotton duct (CD) |  | |  |  |  |  |
| Consortium: Bloom (unspecified mixed culture) | Pirex bottle (250 mL) in water bath shaker | Acrylic | Synthetic | | Heated seed sludge + water | Batch | - | 55 ± 1 | 8 | Wongthanate and Polprasert, 2015 |
| Polyvinylchloride |
| Polyethylene |
| Stainless steel |
| Ramie | Natural | |
| Loofa sponge |
| *Spirulina platensis* | Horizontal disk vertical plates | Nitate acetate cellulose filter (NAM) | Synthetic | | NaHCO3 - free Zarrouk | pilot - batch | EFC 10 | 24 - 32 | 3 | Zhang et al. 2015 |
| Electrostatic flockin cloth (EFC) | FS 9 |
| Foam sponge (FS) | FC 6 |
| Fiber carpet (FC) | SFT 9.2 |
| Superfine fiber towel (SFT9 | NAM 12 |
| *Chlorella* sp. | Filtration photobioreactor (FPBR) | Cellulose membrane (5µm pore) | Natural | | Synthetic medium | Batch | 13.56 | 35 | 2 | Zhang et al. 2014 |
| *Halochlorella rubescens* (CCAC0126) | Twin layer vertical | Nylon filter sheet | Synthetic | | Different wastewater effluents | continuous | 6.6 | 18 - 32 | 32 | Shi et al., 2014 |
| *Chlorella. sorokiniana* | Rotating biological contactor (RBC)- algadisk | Stainless steel woven meshes | Synthetic | | M8-a | Continuous | 15 - 20 | 38 ± 1 | 28 | Blanken et al., 2014 |
| Sanded polycarbonate |
| *Scenedesmus dimorphus* (UTEX 417) | Horizontal chamber on rocker shaker | Glass fiber reinforced plastic (GFRP) | Synthetic | | Modified BBM | Batch | GFRP 1.45 | 26 ± 2 | 15 | Shen et al., 2014 |
| *Chorella. protothecoides* (UTEX 1806) | Plastic film (PF) | PF 0.62 |
| *Chlorella. vulgaris* (FACHB-31) | Silicone film (SF) | SF 1.15 |
| *Scenedesmus obliquus* (FACHB-416) | Maifon stein sheet (MSS) | MSS 1.08 |
| *Scenedesmus dimorphus* (FACHB-496) | Polyethylene foam (PEF) | PEF 1 |
| *Chlorococcum* sp. | Frosted glass (FG) | FG 0.76 |
|  | Plyurethane sheet (PUS) | SSS 0.57 |
|  | Stainless steel sheet (SSS) | PUS 0.62 |
|  | Polycarbonate sheet (PCS) | PCS 0.5 |
| *Nannochloropsis* sp. (isolated)  *Chlorella. vulgaris* (ATCC 13482) | Biostat (2 L) | Mycellium of *Aspergillius nomius* (CCK-PDA 7#6) | Natural | | Guillard f/2 medium  BAR medium | Batch | - | 22 ± 1 | 7 | Talukder et al., 2014 |
|  | Modified ATCC 1174DA medium |
| *Dunaliella tertiolecta* (UTEX L994) |
| Consortium contained:  *Scenedesmus obliquus* (CPCC 157) | Parallel plate airlift reactor (PPAL) | Acrylic (A) | Synthetic | | Municipal wastewater + FBBM (1:2) | Semibatch | A 0.97 | 23 ± 1 | 10 | Genin et al., 2014 |
| *Chlorella vulgaris* (CPCC 147) | Glass (G) | G 1.12 |
| *Nannochloropsis sp.* (CCAP 251/2) | Cellulose acetate (CA) | PC 1.25 |
| *Nitzchia palea* (CPCC 160) | Polystyrene (PS) | PS 1.34 |
| *Oocystis polymorpha* | Polycarbonate (PC) | SR 1.52 |
|  | Silicone rubber (SR) | CA 2.08 |
| *Chlorella vulgaris* (UTEX #265) | Rotating algal biofilm photobioreactor (RABR) | Cotton duct (CD) | Natural | | Mdified BBM | Pilot - semibatch | CD 1.08 ± 0.14 | 26 ± 2 | 7 | Gross et al., 2013 |
| Muslim cheese cloth (MCC) | Test - Batch | C rag 0.70 ± 0.19 |
| Plexiglass chamber on rocker shaker | Chamois leather cloth (CLC) |  | CD denim 0.092 ± 0.008 |
| Vermiculite (V) |  | CD corduroy 0.08 ± 0.06 |
|  | Chamois leather cloth (CLC) |  | CD RABR 3.51 ± 0.48 |
|  | Vermiculite (V) |  | CD-pilot 3.51 ± 0.48 |
|  | Burlap (B) |  |  |
|  | Velvet (V) |  |  |
|  | Armid fiberglass (AF) | Synthetic | |  |  |
|  | PTFE coated fiberglass (PTFE F) |  |  |
|  | Microfiber (MF) |  |  |
|  | Synthetic chamois cloth (SCC) |  |  |
|  | Fliberglass (F) |  |  |
|  | Tyvek (T) |  |  |
|  | Abraised poly-lactic acid (APA) |  |  |
|  | Vinyl laminated nylon (VLN) |  |  |
|  | Polyester |  |  |
| *Scenedesmus obliquus* (CPCC5) | Horizontal parallel Flat plate algal biofilm photobioreactor (HPFP) | Glass | Synthetic | | synthetic medium created (CH4-10) | semibatch | 2.1 | 26 | 21 | Schnurr et al., 2013 |
| *Nitzchia palea* (CPCC160) |
| *Phaeodactylum tricornutum* (UTEX 642) | Twin layer vertical | Plain printed papier | Natural | | Modified f/2 | Pilot - semibatch | 6.1 | 25 | 25 | Naumann et al., 2013 |
| *Tetraselmis sucica* (PLY305) | 5.1 |
| *Isochysis* sp. CCAP 927/14) | 4.2 |
| *Nannochloropsis* sp. (CCAP 28/78) | - |
| *Chlorella vulgaris* (CCALA 924) | Petri dishes | Microscopic glass slides with:  3-aminospropyltriethoxysilane  Propyltriethoxysilane | Synthetic | | Complete mineral medium (CMM) | Batch | - | 25 | 8 | Sirmerova et al., 2013 |
| Microelement limiting medium (MLM) |
| Sulfur limiting medium (SLM) |
| Nitroegn limiting medium (NLM) |
| *Scenedesmus obliquus* | Multiglass plates with algal disks | Cellulose acetate/  nitrate membrane | Natural | | BG-11 | Semibatch | 50 - 80 | 30 ± 2 | 10 | Liu et al., 2013 |
| *Botryococcus.braunii* SAG30.81 |  |  |  | |  |  |  |  |  |  |
| *Nannochloropsis* sp.OZ-1 |  |  |  | |  |  |  |  |  |  |
| *Cylindrotheca fusiformis,* |  |  |  | |  |  |  |  |  |  |
| Consortium contained:  *Scenedesmus* sp. | RABR | Cotton rope | Natural | | conditioned municipal wastewater | Semibatch | pilot 20-31 | 14 - 24 | 26 | Christenson and Sims, 2012 |
| *Nitzchia* sp. | high treated cotton | Test, medium and pilor scales | test 5.5 |
| *Navicula* sp.  Dominated by: | Jute |  |
| *Pediastrum* sp.  *Diatoma* sp.  *Chlorella* sp. | Nylon | Synthetic | |  |
|  | Polypropylene |  |
|  | Acrylic |  |
|  |  |  |  |
|  |  |  |  |
| *Botryococcus braunii* (LB572) | Horizontal flat chamber | Concrete (8 m thicker) | Synthetic | | BG 11 | semibatch | 0.7 | 25 | 35 | Ozkan et al., 2012 |
| Consortia from facultative wastewater stabilization ponds (WWSP)  Algae species unspecified | Zeolite RPB | Clinoptilolite | Natural | | Synthetic wastewater | Batch | 12 | 21 ± 2 | 21 | Young, 2011 |
| Consortia scraped off the surface of a settling tank of the effluent of the municipal WWTP.  Algae species unspecified | Flow cell | Poly-vinylchloride (PVC) plastic sheet | Synthetic | | Synthetic wastewate | Batch | 2.1 – 7.7 | 22 | 16 | Boelee et al., 2011 |
| *Chlorella* sp. (isolated) | Plexiglass chamber on rocker shaker | Polyestirene foam (PF) | Synthetic | | Dairy manure wastewater | semibatch | PF 2.57 ± 0.03 | 20 | 15 | Johnson and Wen, 2010 |
| Cardboard (CB) | CB 1.47 ± 0.04 |
| Polyethylene landscape fabric (PLF) | PLF 0.58 ± 0.04 |
| Polyurethane foam (PF) | LS 1.28 ± 0.20 |
| Nylon sponge (NS) |  |
| Lofah sponge (LS) | Natural | |  |
| *Scenedesmus dimorphus* (UTEX 417) | Conveyor belt floating system | Stainless steel | Synthetic | | Modified BBM | Batch | - | 22 | 2 | Cao et al., 2009 |
| *Amphora* sp. | Bistles photo-bioreactor PBB | Plolyvinyl chloride (PVC) bristles | Synthetic | | Seawater + F/2m | Batch | - | 20± 2 | 7 | Silva-Aciares and Riquelme, 2008 |
| *Navicula* sp. |  | |  |  |  |  |
| *Nitzschia ovalis*  *Cylindrotheca closterium* |  | |  |  |  |  |