

Table S1 Life cycle inventory of microalgal cultivation via photoautotrophic and heterotrophic modes of nutrition

Unit Operation	Value	Units
Cultivation		
Airlift Photobioreactor		
Electrical Energy	2.47	MJ/ kg biomass
Biomass concentration	1.74	kg/ m ³
Lipid content	20	%
EPA+DHA Content	15	% of Lipids
Sodium Nitrate	0.241	kg/ kg biomass
Magnesium Sulphate	0.043	kg/ kg biomass
Sodium Chloride	17.23	kg/ kg biomass
Calcium Chloride	0.02	kg/ kg biomass
Fermenter		
Electrical Energy	3.88	MJ/ kg of biomass
Biomass concentration	30	Kg/m ³
EPA+DHA content	0.06	kg/ kg of biomass
Glucose	2	kg/ kg of biomass
Sodium Chloride	0.32	kg/ kg of biomass
Yeast Extract	0.32	kg/ kg of biomass
Harvesting		
Flocculation (A)		
Magnesium Hydroxide	0.09	kg/ kg of biomass
Electrical Energy	0.0007	MJ/ kg of biomass
Centrifugation (H)		
Electrical Energy	0.815	MJ/ kg of biomass
Spray drying		
Steam (H)	5.53	MJ/ kg of biomass
Steam (A)	4.26	MJ/ kg of biomass
Lipid extraction & refining		
Algal meal (H)	0.74	kg/ kg of biomass
Lipids (H)	0.26	kg/ kg of biomass
Algal meal (A)	0.8	kg/ kg of biomass
Lipids (A)	0.2	kg/ kg of biomass
Phosphoric Acid (A)	0.03	kg/ kg of degummed oil
Sodium Hydroxide (A)	0.01	g/ kg of neutralised oil
Fullers earth (A)	0.789	g/ kg of bleached oil
Activated carbon (A)	0.233	g/ kg of bleached oil
Phosphoric acid (H)	0.01	kg/ kg of degummed oil
Sodium Hydroxide (H)	0.005	g/ kg of neutralised oil
Fullers Earth (H)	0.395	g/ kg of bleached oil
Activated Carbon (H)	0.116	g/ kg of bleached oil

*A- Photoautotrophy; H- Heterotrophy; EPA- Eicosapentanoic Acid; DHA-Docosahexanoic Acid

Table S2 Life cycle inventory of fish farming and oil extraction from fish biomass

Unit Operation	Value	Units
Cultivation		
Diesel	1.72	MJ per kg of fish
Gasoline	1.29	MJ per kg of fish
Natural gas	39.7	MJ per kg of fish
Electricity	1.06	MJ per kg of fish
Crude oil	0.00166	MJ per kg of fish
Feed	1.3	Kg per kg of fish
EPA+DHA	22	g per kg of fish
Cold Storage		
Electricity	0.0518	MJ per kg of fish
Mincing		
Electricity	0.274	MJ per kg of fish
Cooking		
Steam	471	MJ per kg of fish
Centrifugation		
Electricity	0.445	MJ per kg of oil
Refining of oil		
Electricity	0.03	MJ per kg of degummed oil
Phosphoric acid	0.01	kg per kg of degummed oil
Sodium Hydroxide	0.01	g per kg of neutralised oil
Fullers earth	0.79	g per kg of bleached oil
Activated carbon	0.23	g per kg of bleached oil
Acetic acid	0.09	g per kg of omega-3 fatty acid

Table S3 Environmental impacts of EPA+DHA production from microalgal biomass via photoautotrophic and heterotrophic mode of nutrition and from Farmed Fish**Photoautotrophy**

	Cultivation	Extraction	Harvesting	Oil Refining	Spray Drying
ADP elements	0.0185	6.14E-09	0.000104	3.44E-09	1.14E-06
ADP fossil	1.47E+03	1.61	165	0.188	348
AP	0.721	5.03E-05	0.0281	1.83E-05	0.0107
EP	0.174	7.78E-06	0.00446	2.06E-06	0.00188
FAETP	0.516	0.000209	0.024	8.49E-06	0.00592
GWP	112	0.0777	14.2	0.0156	20.8
HTP	4.42	0.00159	0.464	0.000441	0.308
MAETP	4.79E+03	1.1	1.21E+03	0.981	133
ODP	2.72E-11	4.32E-17	1.10E-09	6.50E-17	1.34E-15
POCP	0.076	8.97E-06	0.00231	1.72E-06	0.00176
TETP	0.224	0.000102	0.16	9.61E-06	0.0178

*ADP- Abiotic Depletion Potential; AP- Acidification Potential; EP- Eutrophication Potential; FAETP- Freshwater Aquatic Ecotoxicity Potential; GWP- Global Warming Potential; HTP- Human Toxicity Potential; MAETP- Marine Aquatic Ecotoxicity Potential; ODP- Ozone Depletion Potential; POCP- Photochemical Ozone Creation Potential; TETP- Terrestrial Ecotoxicity Potential

Heterotrophy

	Cultivation	Extraction	Harvesting	Oil Refining	Spray Drying
ADP elements	0.0011	6.62E-09	5.61E-06	1.38E-05	9.39E-07
ADP fossil	986	2.05	185	14.3	418
AP	0.211	0.000266	0.035	0.00225	0.0838
EP	0.0289	2.24E-05	0.00389	0.000432	0.00668
FAETP	0.209	0.000759	0.037	0.00209	0.179
GWP	87.9	0.124	16.8	1.26	33.9
HTP	3.77	0.00861	0.732	0.0398	2.69
MAETP	9.86E+03	3.14	2.00E+03	102	765
ODP	4.06E-11	6.52E-17	5.02E-13	3.73E-14	4.85E-15
POCP	0.0165	2.38E-05	0.0025	0.000183	0.00644
TETP	0.102	0.000204	0.0183	0.00179	0.0472

Fish Oil

	Cold Storage	Cooking	Farming	Mincing	Oil refining fish	Pressing and centrifugation
ADP elements [kg Sb eq.]	8.23E-05	0.000583	0.00256	0.000435	4.50E-06	5.66E-05
ADP fossil [MJ]	2.72E+03	1.78E+05	2.26E+06	1.44E+04	136	1.87E+03
AP [kg SO2 eq.]	0.514	5.47	72.4	2.72	0.025	0.353
EP [kg Phosphate eq.]	0.057	0.961	5.05	0.302	0.00279	0.0392
FAETP [kg DCB eq.]	0.542	3.03	68	2.86	0.0266	0.373
GWP 100 years [kg CO2 eq.]	247	1.06E+04	2.95E+04	1.30E+03	12.1	170
HTP [kg DCB eq.]	10.7	157	558	56.7	0.522	7.37
MAETP [kg DCB eq.]	2.93E+04	6.77E+04	1.86E+06	1.55E+05	1.42E+03	2.01E+04
ODP [kg R11 eq.]	7.35E-12	6.86E-13	1.52E-10	3.89E-11	3.56E-13	5.06E-12
POCP [kg Ethene eq.]	0.0366	0.898	8.48	0.194	0.00179	0.0252
TETP [kg DCB eq.]	0.268	9.09	26.3	1.42	0.0133	0.184