Co-Culture of Diatoms and Microalgae for improvement in aquaculture ecosystem with development of resources for green energy production- A sustainable model for self-reliable economics and environment.

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Commercial aquaculture practice and its environmental impact

- Due to rapid commercialization in aquaculture practices, there is extensive use of chemical fertilizers, synthetic/ chemical pesticides, antibiotics, synthetic hormones, Formulated feed and food additives etc.

- Most of them end up as pollutant such as uneaten food, faeces, dissolved nutrients, scales, mucous, dissolved chemical antibiotics, fertilizers and pesticides etc. This enables extensive pollution in the receiving waters that badly affect the ecosystem, environment and species in the receiving water.

- The nitrogen and phosphorous rich feed encompasses Algal bloom or eutrophication in the receiving water enabling high BOD level and low DO level.

- The excessive nitrogen in the water causes ammonia toxicity due to accumulation of ammonia in receiving water. The chemical fertilizers, pesticides change the physical and chemical environment of the receiving water. These can also affect the health of main aquaculture if they are not being monitored and controlled effectively in main culture pond/production ponds.

Chaetoceros – A better and reliable self sufficient alternative

- ✓ ***Chaetoceros*** (Plankton) grown along with the aquaculture help in efficient re-cycling of the nutrients and thereby maintaining natural nutrient cycle for growing population of aquaculture fishes, increase DO level, decrease the level of toxic contaminants, act as a natural predator for different parasites and pests, promotes food chain cycle as they can be primary sources of feed for larva and many more.

- ✓ This will also help in reduction in dependency on chemical or synthetic entities leading to lesser generation of pollutant and increasing the healthiness of the aquaculture thereby maintaining natural ecosystem. This in turn also helps restoration of the down town ecosystem stabilizing both commercial and natural ecosystem.

- ✓ More important, these models can be also being helpful for farmers those who can produce and supply to these large aquaculture firms results in rural livelihood self-sustained model of employment and economy. This indeed will also reduce dependency of those anthropological entities on environment.

Study Profile

- ✓ Study was done on by isolation of ***Chaetoceros calcitrans*** isolated from Brackish water downstream to commercial aquaculture (20-30 kms downstream).
- ✓ Site was selected – Commercial aquaculture On-sites at Chilika Lake, East coast, India.
- ✓ Study Design

1. Culture Parameters optimization (Temperature, culture media, indoor/outdoor conditions) based on study of cell density and estimating growth rate.
2. Nutritional characterization- Total organic matter, Total protein content, total carbohydrate content, total protein content.
3. FAME-GC analysis to find fatty acid content.
4. Physiological Characteristics of *Penaeus monodon* (Tiger prawn) and *Fenneropenaeus indicus* (common Indian prawn) co-cultured with *Chaetoceros* was studied to find suitability of microalgae for sustainable aquaculture practice.

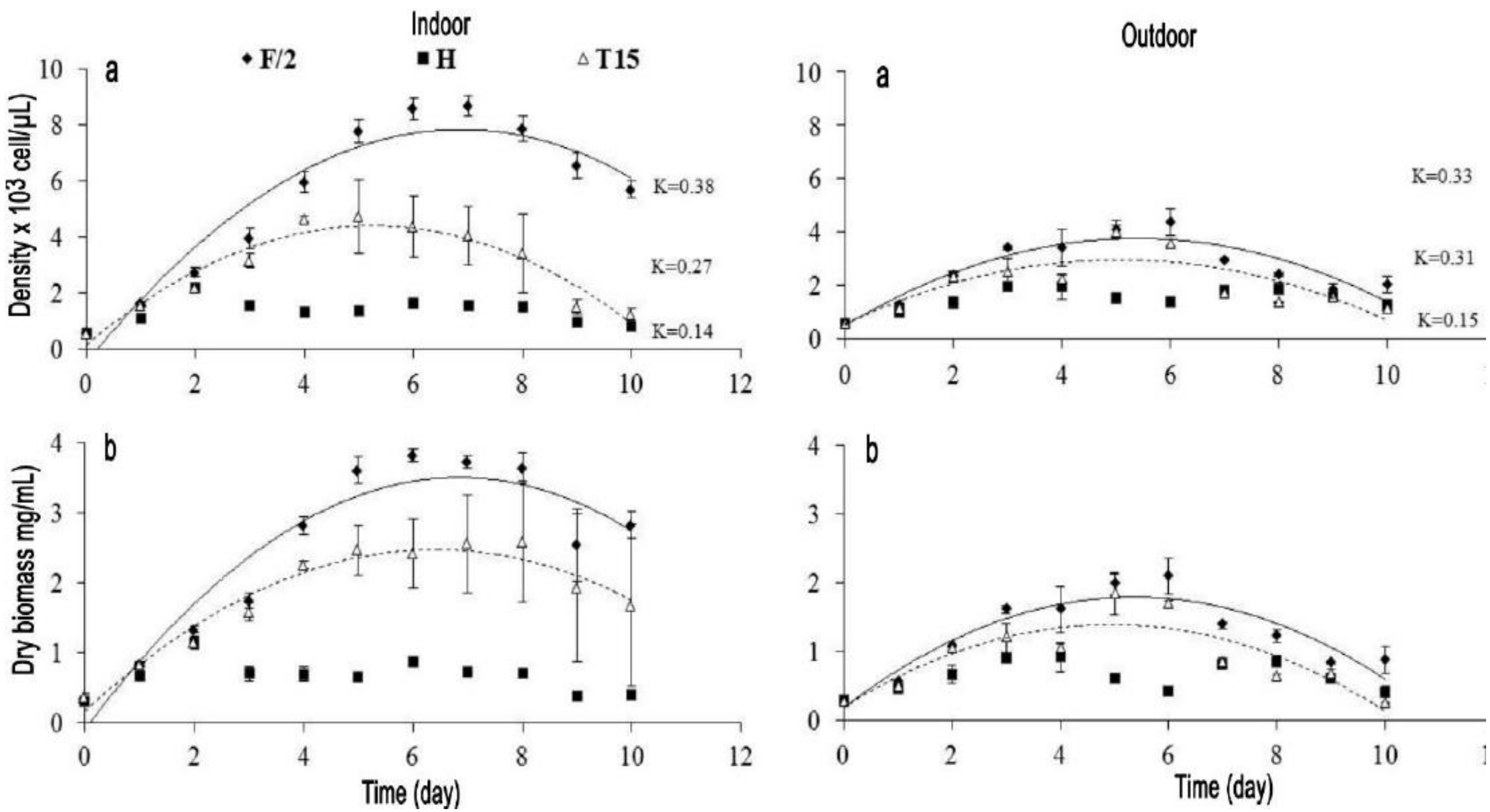
Parametres Optimization

- ✓ Indoor at 24ºC ± 0.5ºC
- ✓ Guillard f media (F/2; Guillard 1975)
- ✓ 18 hours light cycle with fluorescent illumination (3300 lumens),
- ✓ Salinity index - 35
- ✓ Cellular concentration equivalent 18.3 ± 0.4x10^6 cells

Nutritional assessment of *Chaetoceros calcitrans*

Parametres	Chaetocerous calcitrans
Particulate Organic matter	**81.4±6.5**
Size (µm)	**5.2±1.2**
Protein (%age)	**42.8±0.7**
Lipids (%age)	**24.8±1.8**
Carbohydrate (%age)	**32.7±0.8**
Energetic Content (J mg-1)	**25.2±0.6**

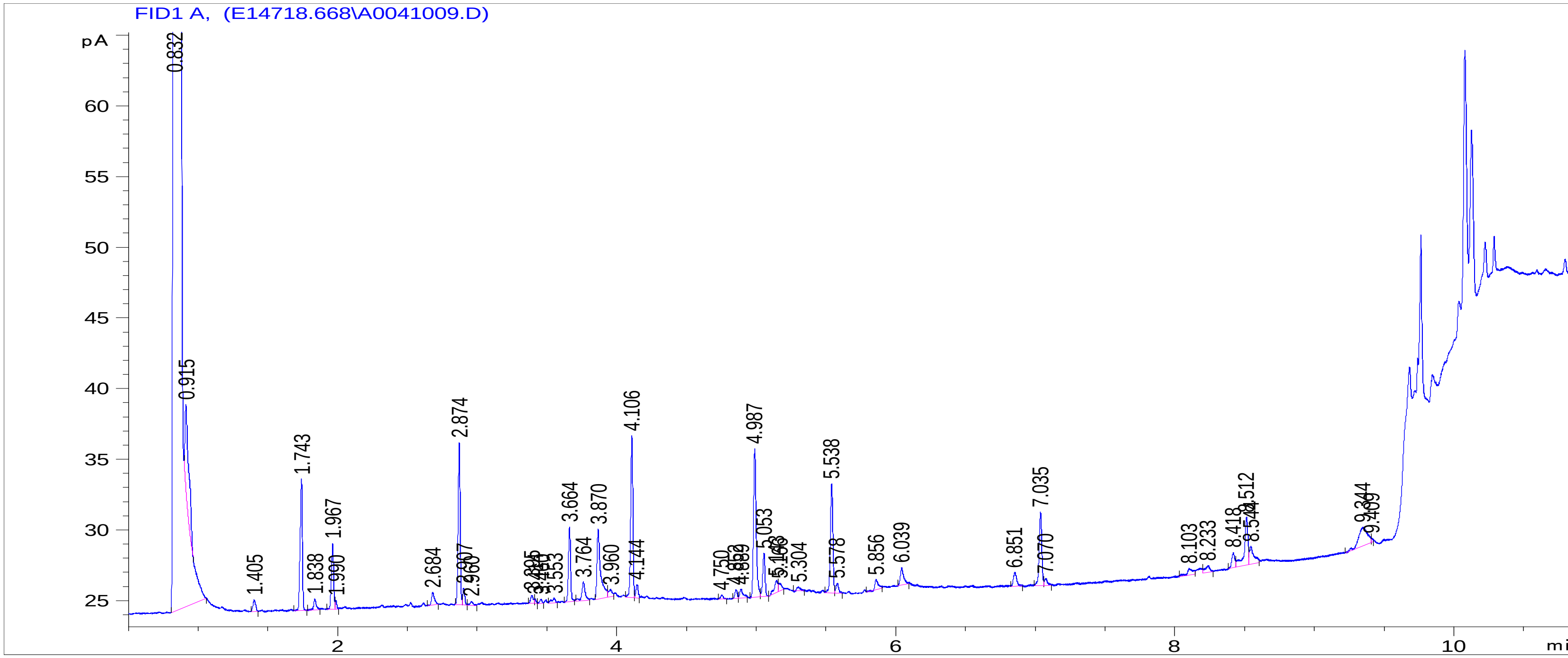
Parametres Optimization- Outdoor/indoor conditions



FAME-GC analysis of *Chaetoceros*

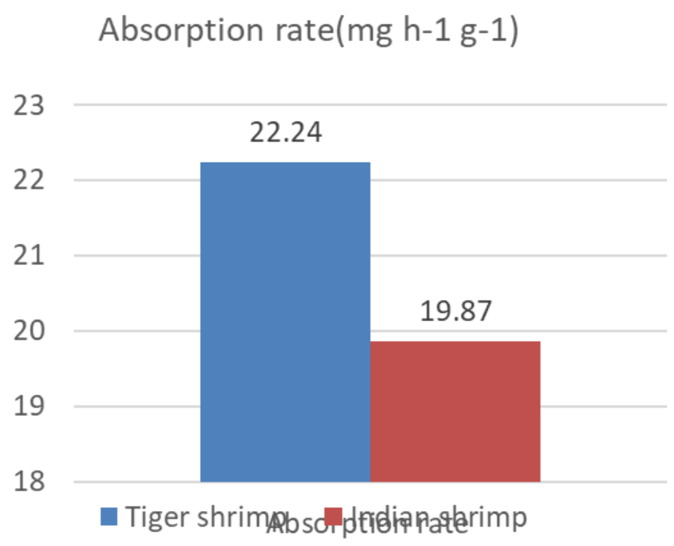
RT	Response	Ar/Ht	RFact	ECL	Peak Name	Percent	Comment1	Comment2
0.8325	2.374E+9	0.021	----	7.7386	SOLVENT PEAK	----	< min rt	
0.9148	26110	0.028	----	8.1567		----	< min rt	
1.4045	2171	0.016	----	10.6385		----		
1.7432	20849	0.016	1.322	11.9991	12:0	14.93	ECL deviates -0.001	Reference 0.011
1.8383	1965	0.016	----	12.2726		----		
1.9669	10053	0.016	----	12.6426		----		
1.9904	1022	0.011	1.234	12.7102	13:0 anteiso	0.68	ECL deviates 0.001	Reference 0.010
2.6843	2538	0.018	1.084	14.2906	14:1 w7c DMA	1.49	ECL deviates 0.003	
2.8742	23798	0.016	1.057	14.6508	15:3 w3c	13.63	ECL deviates -0.009	
2.9068	2490	0.013	1.054	14.7126	15:0 anteiso	1.42	ECL deviates 0.002	Reference 0.004
2.9596	886	0.019	1.048	14.8129	15:1 w8c	0.50	ECL deviates 0.014	
3.3946	1578	0.017	1.004	15.5536	16:0 N alcohol	0.86	ECL deviates -0.003	
3.4144	466	0.009	----	15.5863		----		
3.4602	673	0.014	----	15.6617		----		
3.5529	1207	0.021	0.991	15.8143	16:1 w7c	0.65	ECL deviates -0.010	
3.6644	11004	0.016	0.983	15.9978	16:0	5.86	ECL deviates -0.002	Reference -0.003
3.7643	4481	0.021	0.977	16.1471	16:2 DMA	2.37	ECL deviates 0.003	
3.8697	17837	0.024	0.970	16.3043	16:1 w7c DMA	9.38	ECL deviates -0.006	
3.9596	1970	0.023	----	16.4384		----		
4.1062	25284	0.017	----	16.6571		----		
4.1440	2061	0.014	0.956	16.7133	17:0 anteiso	1.07	ECL deviates -0.007	
4.7504	735	0.015	0.933	17.5785	18:3 w6c	0.37	ECL deviates -0.008	
4.8519	1412	0.014	0.930	17.7202	18:2 w6c	0.71	ECL deviates -0.007	
4.8891	2237	0.021	0.929	17.7721	18:1 w9c	1.13	ECL deviates -0.002	
4.9870	28775	0.020	0.926	17.9087	18:1 w5c	14.44	ECL deviates -0.010	
5.0528	7010	0.014	0.925	18.0006	18:0	3.51	ECL deviates 0.001	Reference -0.003
5.1428	3328	0.023	----	18.1223		----		
5.1659	1561	0.018	0.923	18.1535	18:2 DMA	0.78	ECL deviates 0.010	
5.3043	737	0.020	----	18.3407		----		
5.5379	19501	0.019	0.916	18.6563	19:3 w3c	9.68	ECL deviates -0.002	
5.5777	1858	0.016	----	18.7102		----		
5.8565	2505	0.021	----	19.0851		----		
6.0392	4194	0.020	0.911	19.3271	19:0 cyclo 9,10 DMA	2.07	ECL deviates 0.003	
6.8514	3206	0.020	----	20.4112		----		
7.0347	13786	0.017	0.907	20.6559	21:3 w3c	6.78	ECL deviates 0.002	
7.0699	1478	0.019	----	20.7029		----		
8.1025	2587	0.034	----	22.0915		----		
8.2334	2282	0.028	----	22.2712	Phthalate 2	----	ECL deviates -0.012	
8.4183	3301	0.020	0.907	22.5251	23:4 w6c	1.62	ECL deviates 0.054	
8.5120	12318	0.025	0.907	22.6537	23:3 w3c	6.05	ECL deviates 0.009	
8.5444	5286	0.026	----	22.6982		----		

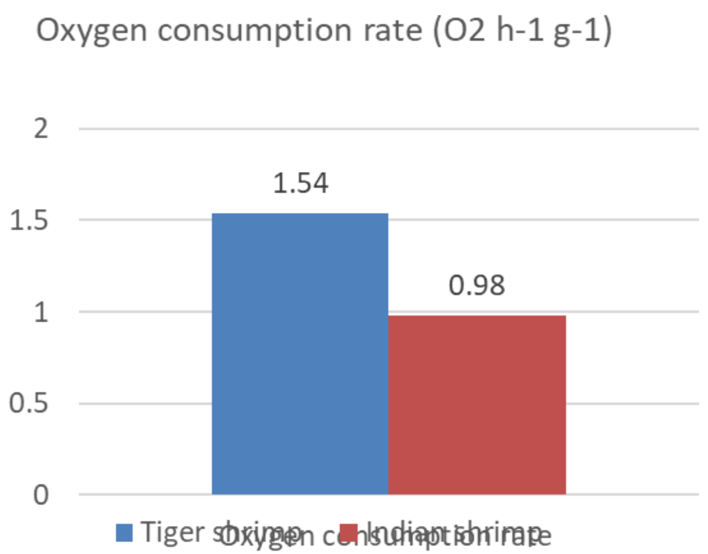
FAME GC- Chromatogram and Analysis

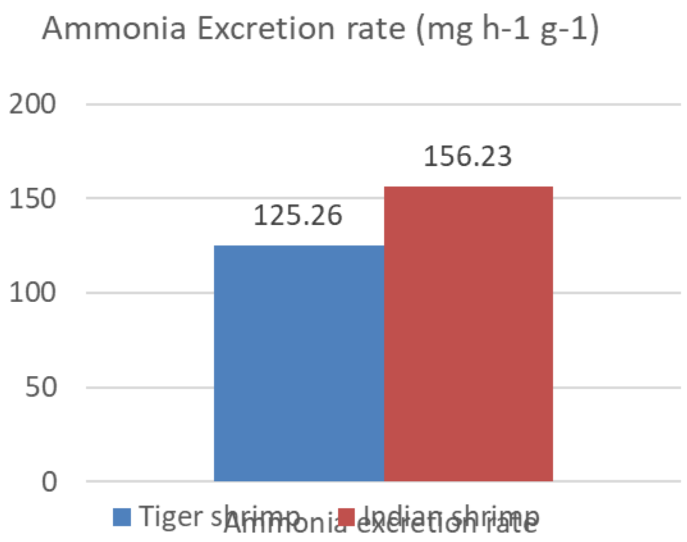


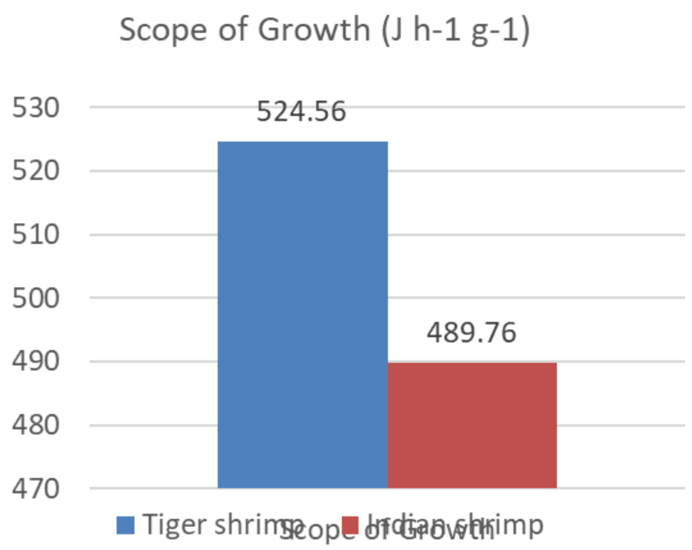
Sl.No.	Sample ID	Straight	Branched	Cyclo	MUFA	PUFA	DMA	18:1 w9c	18:2 w6, 9c	10-methyl
1	S1	**24.52**	**3.20**	**-**	**25.19**	**38.47**	**6.77**	**1.14**	**0.72**	**-**

Physiological studies of Prawns co-cultures with Chaetoceros

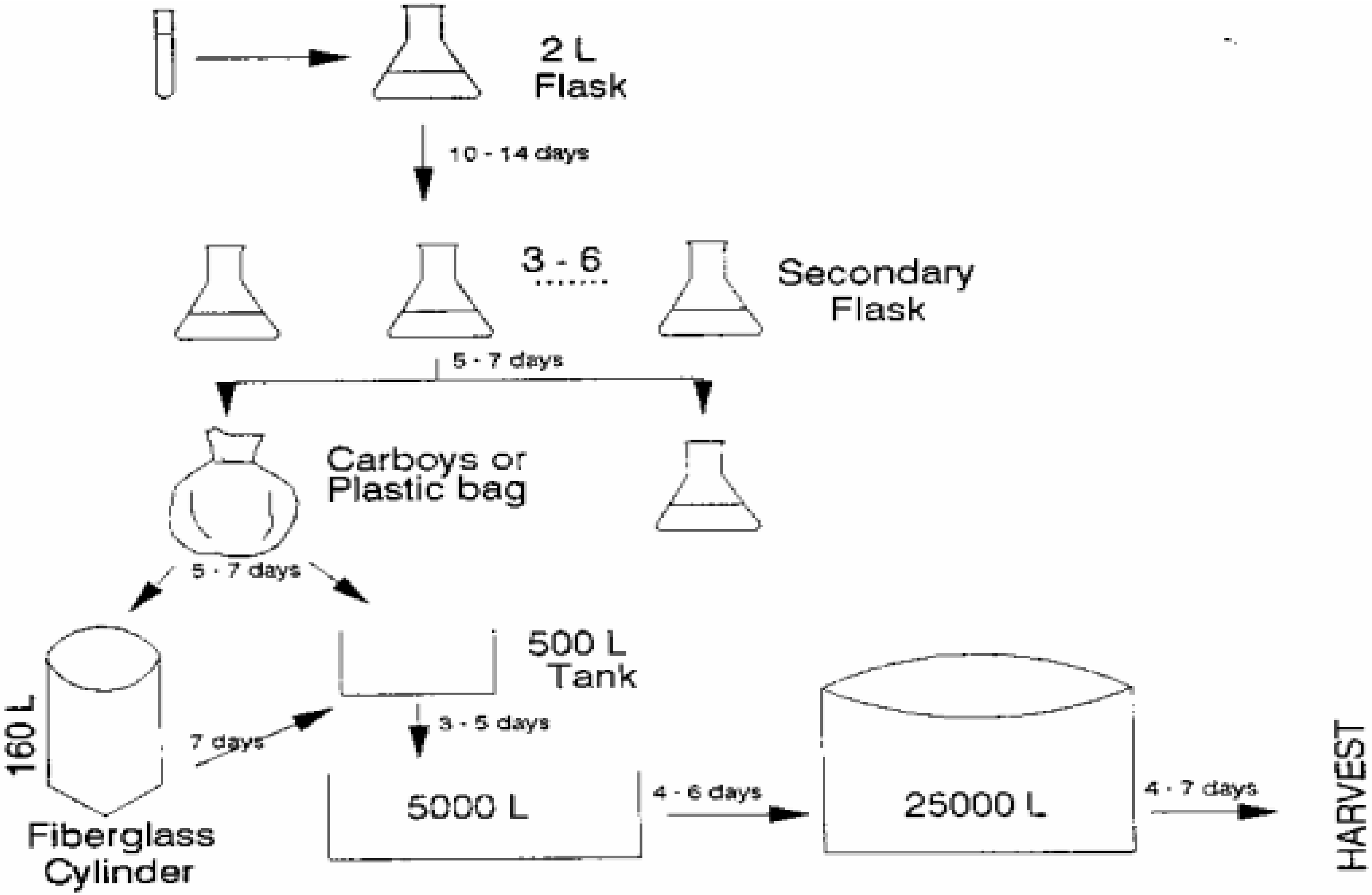








Schematic representation of progression of phytoplankton culture

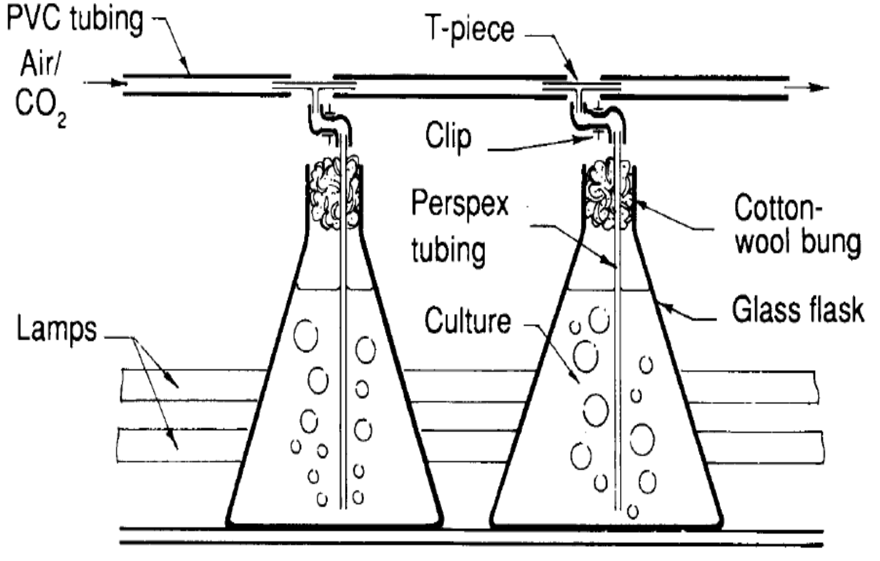


Scaling up of culture production

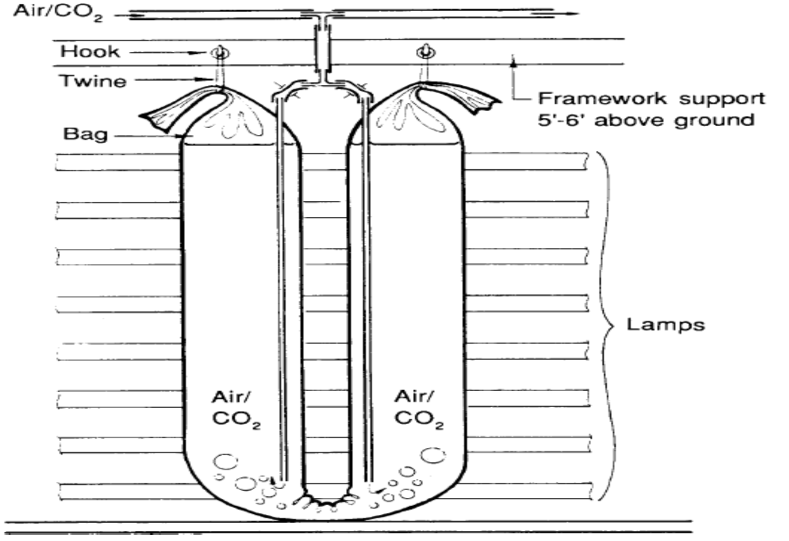
Table 2.2. A generalized set of conditions for culturing micro-algae (modified from Anonymous, 1991).

Parameters	Range	Optima
Temperature (°C)	16-27	18-24
Salinity ($g.l^{-1}$)	12-40	20-24
Light intensity (lux)	1,000-10,000 (depends on volume and density)	2,500-5,000
Photoperiod (light:dark, hours)		16:8 (minimum) 24:0 (maximum)
pH	7-9	8.2-8.7

Primary culture and subculture in laboratory

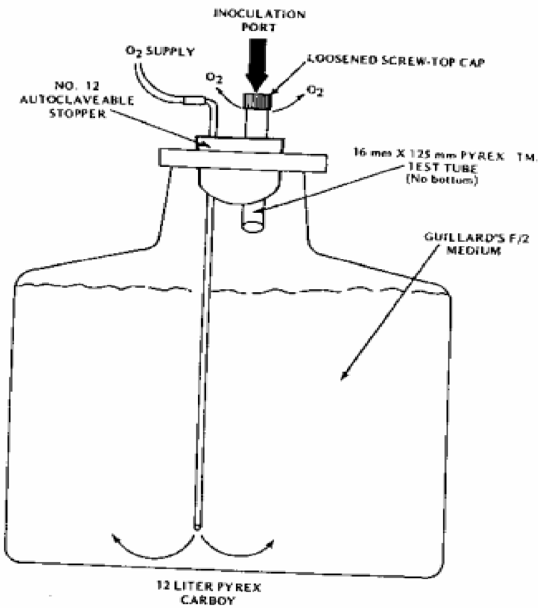


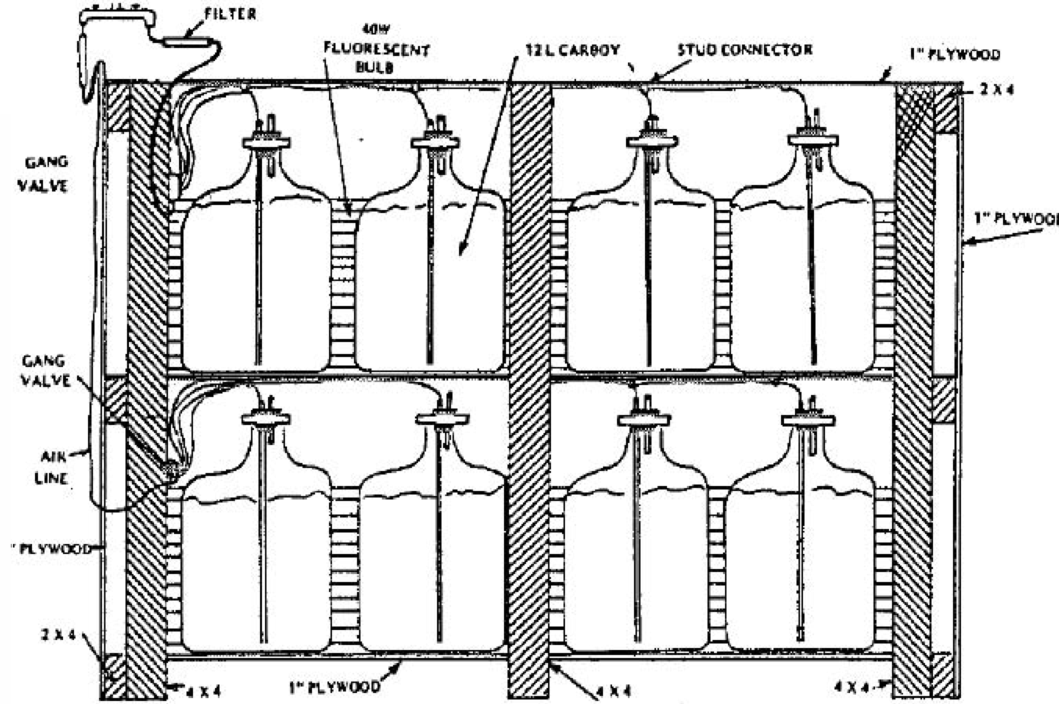
Flask subculturing

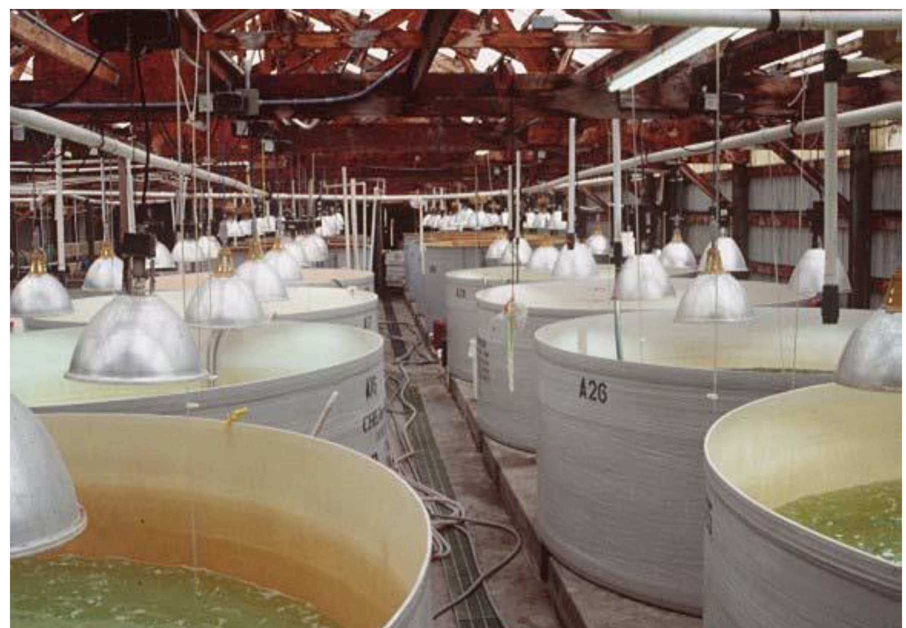


Scaling up of cultures in poly bags upto 60 litres

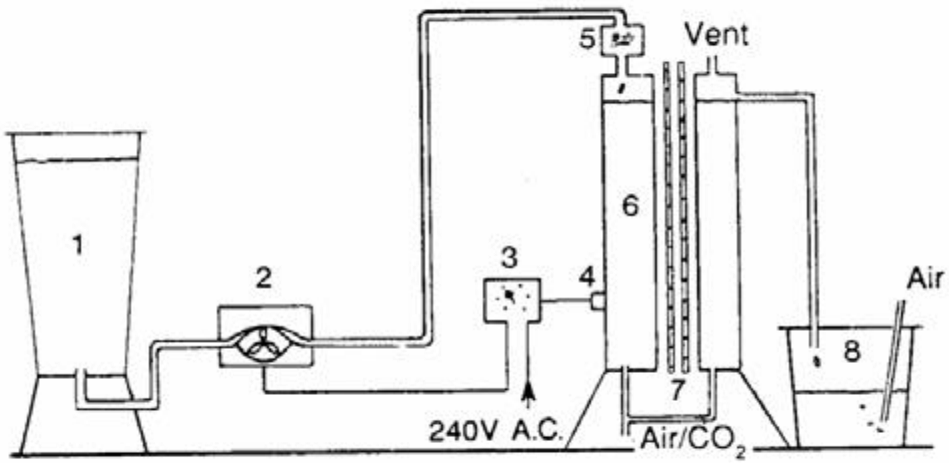
Carboy culture apparatus







CONTINUOUS CULTURE APPARATUS



RURAL LIVELIHOOD ENHANCEMENT

- The basic objective behind the innovation is for promoting and support to increase the socio-economic development by establishing Technology Entrepreneurship Zones in rural and urban areas.

- This programs will directly or indirectly support farmers of rural area for employment which will enhances their livelihood.

- The important point, the technology can be transferred to farmers where they can easily startup their own production units and can give an employment for the fellow beings.

- In India supplying the diatom for Hatcheries for the growth of larval of shrimp, in the same we can develop the culture and sell the culture for farmers for their production of diatom in large scale according to requirement.

THANK YOU !!!!!!

FOR YOUR

PATIENCE

AND

PRECIOUS TIME