

Aquaponic experiment with *Litopenaeus vannamei* and microalgae

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The goal of the experiment

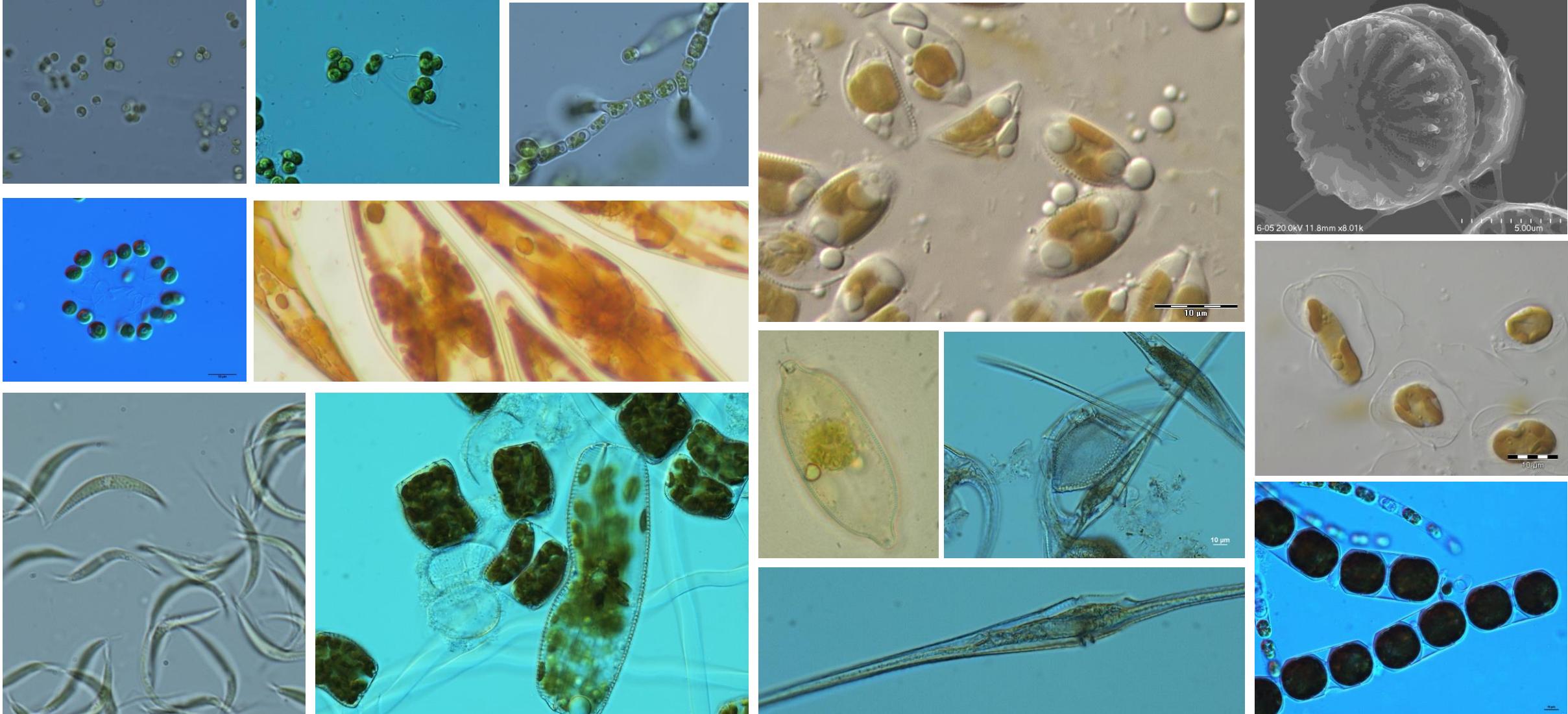


Litopenaeus vannamei; photo: Piotr Kendzierski



Recirculating Aquaculture System (RAS); photo: Basia Dmochowska

Diversity of microalgae



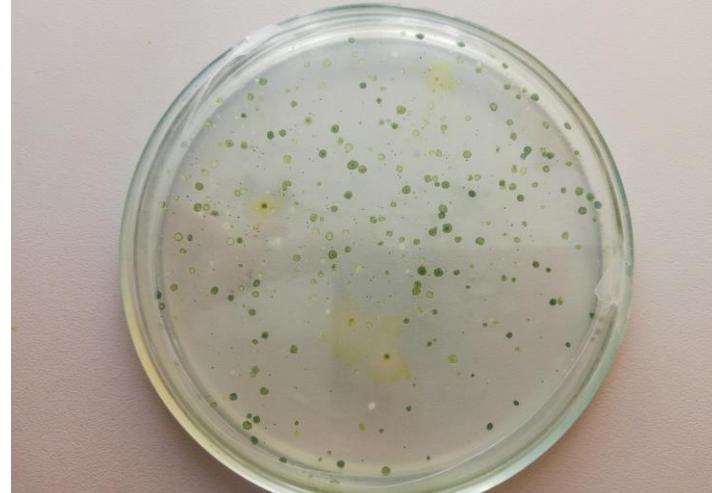
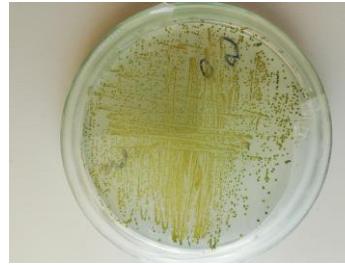
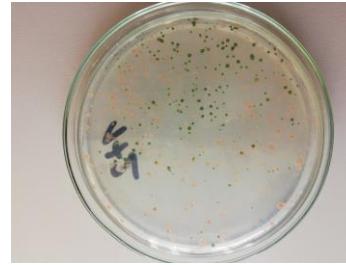
Looking for a proper strain...



The use of existing resources
from algal culture collection



New strains
isolation



Which strain is the proper one?

In terms of growth

- Fast growing
- High-yield biomass production

In terms of the biomass usage

- High lipid, carbohydrates and/or protein content
- High photosynthetic pigments content
- Producing specific biologically active compounds

The use of RAS wastewater as a microalgal growth medium



What is important?

		18x200	18x50	GA
Culturing variant	control	1	2	3
pH		7,82	6,8	7,6
PSU	20	18,8	21,3	20,6
Nutrients:				
NO ₃ ⁻ [mg/l]	12,3	7,2	212,6	9,6
NH ₄ ⁺ [mg/l]	-	-	-	-
PO ₄ ³⁻ [mg/l]	1,12	2,94	9,88	6,48
SiO ₂ [mg/l]	2,96	18	25	18
N:P	24,4:1	5,4:1	47,5:1	3,2:1

- Salinity
- Nutrient concentrations
- Nitrogen source
- N:P ratio

Light: 50 µmol photons m⁻² s⁻¹

Photoperiod: L:D 16h:8h

Temperature: 20°C

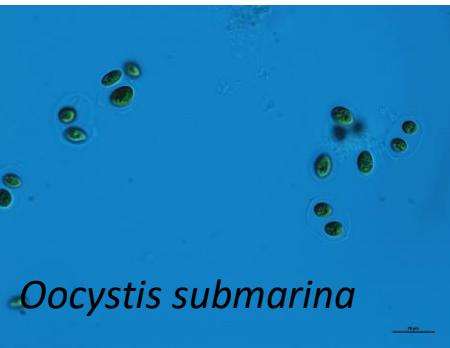
The use of RAS wastewater as a microalgal growth medium



Adapting strains to increased salinity



The use of RAS wastewater as a microalgal growth medium



Species	GROWTH RATE [d^{-1}]	Cultivation variant			
		control	1	2	3
<i>Bacillaria cf. paxillifera</i>	0,33	0,41	0,43	0,39	
<i>Nitzschia microcephala</i>	0,58	0,50	0,54	0,53	
<i>Navicula perminuta</i>	0,46	0,46	0,59	0,50	
<i>Oocystis submarina</i>	0,56	0,51	0,59	0,57	

The use of RAS wastewater as a microalgal growth medium



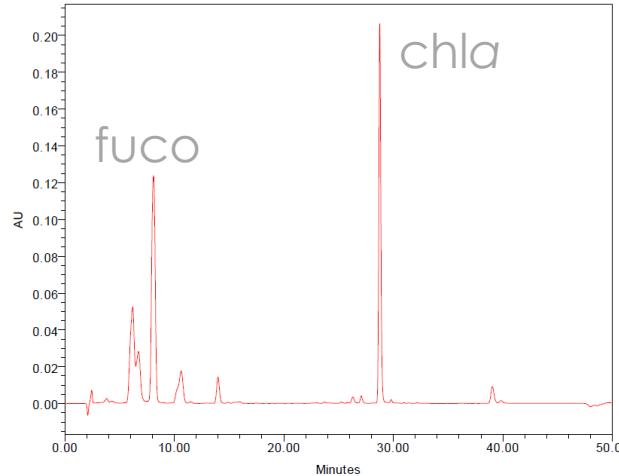
		culturing variant		
		1	2	3
<i>Bacillaria cf. paxillifera</i>	proteins*	113,8	184,3	51,0
	carbohydrates*	35,1	47,5	40,6
	lipids*	148,3	152,9	136,0
<i>Nitzschia microcephala</i>	proteins*	88,8	116,0	91,7
	carbohydrates*	72,3	105,3	131,8
	lipids*	144,5	151,9	146,8
<i>Navicula perminuta</i>	proteins*	78,9	114,7	96,3
	carbohydrates*	85,0	85,7	60,6
	lipids*	160,1	154,6	145,9

* [mg/l]

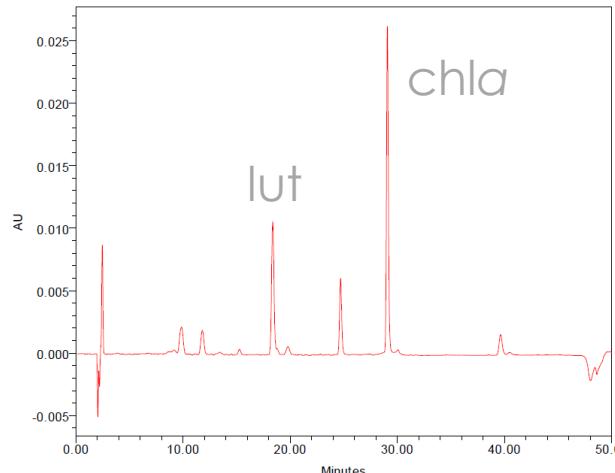
The use of RAS wastewater as a microalgal growth medium



Bacillaria cf. paxillifera



Oocystis submarina



		culturing variant		
		1	2	3
<i>Bacillaria cf. paxillifera</i>	chl a*	3,22	4,90	3,42
	fuco*	1,38	1,87	1,48
	fuco/chla	0,43	0,38	0,43
<i>Nitzschia microcephala</i>	chl a*	2,08	2,59	0,87
	fuco*	0,84	0,99	0,36
	fuco/chla	0,40	0,38	0,41
<i>Navicula perminuta</i>	chl a*	1,49	4,05	2,34
	fuco*	0,64	1,71	1,09
	fuco/chla	0,43	0,42	0,47
<i>Oocystis submarina</i>	chl a*	0,19	0,67	0,30
	lut*	0,06	0,17	0,09
	lut/chla	0,29	0,25	0,28

chl a – chlorophyll a
fuco – fucoxanthin
lut – lutein
[mg/l]

The use of RAS wastewater as a microalgal growth medium



Troubleshooting – how to increase the biomass yield?

Problems	Solutions
Inappropriate strain selection	Proper strain choice → (gradual) adaptation process
Too low light and temperature conditions	Adjustment of cultivation conditions (such as light, temperature) to increase the productivity yield
Inappropriate nutrients proportion and/or lack of microelements	Addition of nutrients and microelements to improve microalgal growth
Excessive bacteria growth and „biological invasions”	Understanding algal-bacterial relationship and „synthetic ecology”

What did the experiment teach?

- RAS wastewater can be successfully used as a medium for growing microalgae
- Baltic microalgae constitute a promising source of strains to be grown in RAS wastewater with elevated salinity (after adaptation process)
- The quality of biomass is sufficiently good to be further processed for various commercial purposes



Thank you for your attention