

# **Novel culture feed for short-neck clam using single-cell material from *Porphyra***

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## Research Background (Nori culture in Japan)

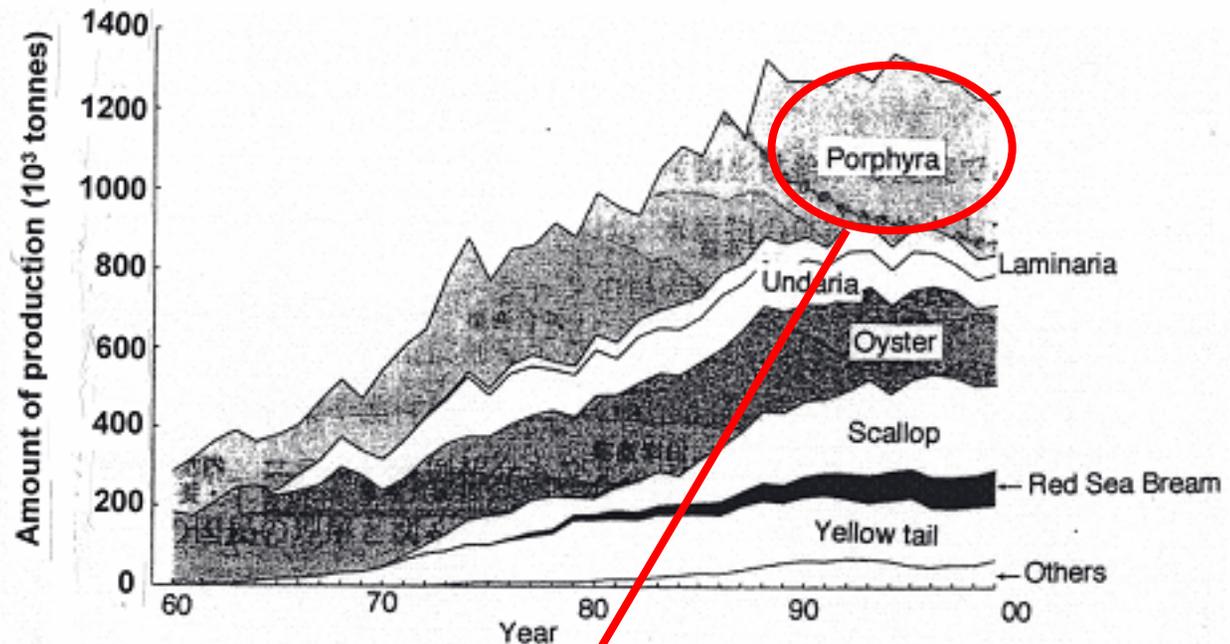


Fig. Change in the amount of mariculture production in Japan.

Purple lavers (*Porphyra* spp., Nori) are known to be one of the most nutritious edible macroalgae (red algae) and the aquaculture of *Porphyra* spp. is an important industry in Japan (1-1.5 billion US\$ industry).

## Research Background

### Problems of *Porphyra* culture in Japan

(Quality deterioration, Overproduction, Export rash from neighbouring countries by FTA.)

To secure aquafarmers' life and *Porphyra* culture industry

How ?

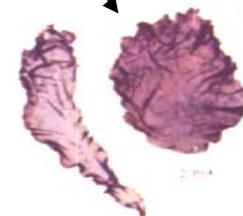
By adding new economical values,  
create novel utilization method and  
enhance its consumption.

New research project

Title: **Studies on the effective utilization of  
low-grade *Porphyra* by enzymatic means  
(2005–7)**



Harvest of *Porphyra*



## Research Background 2



*Ruditapes philippinarum*  
(Short-neck clam, Manila clam, Asari)

Domestic consumption: Several hundred thousand MT



Asari soup



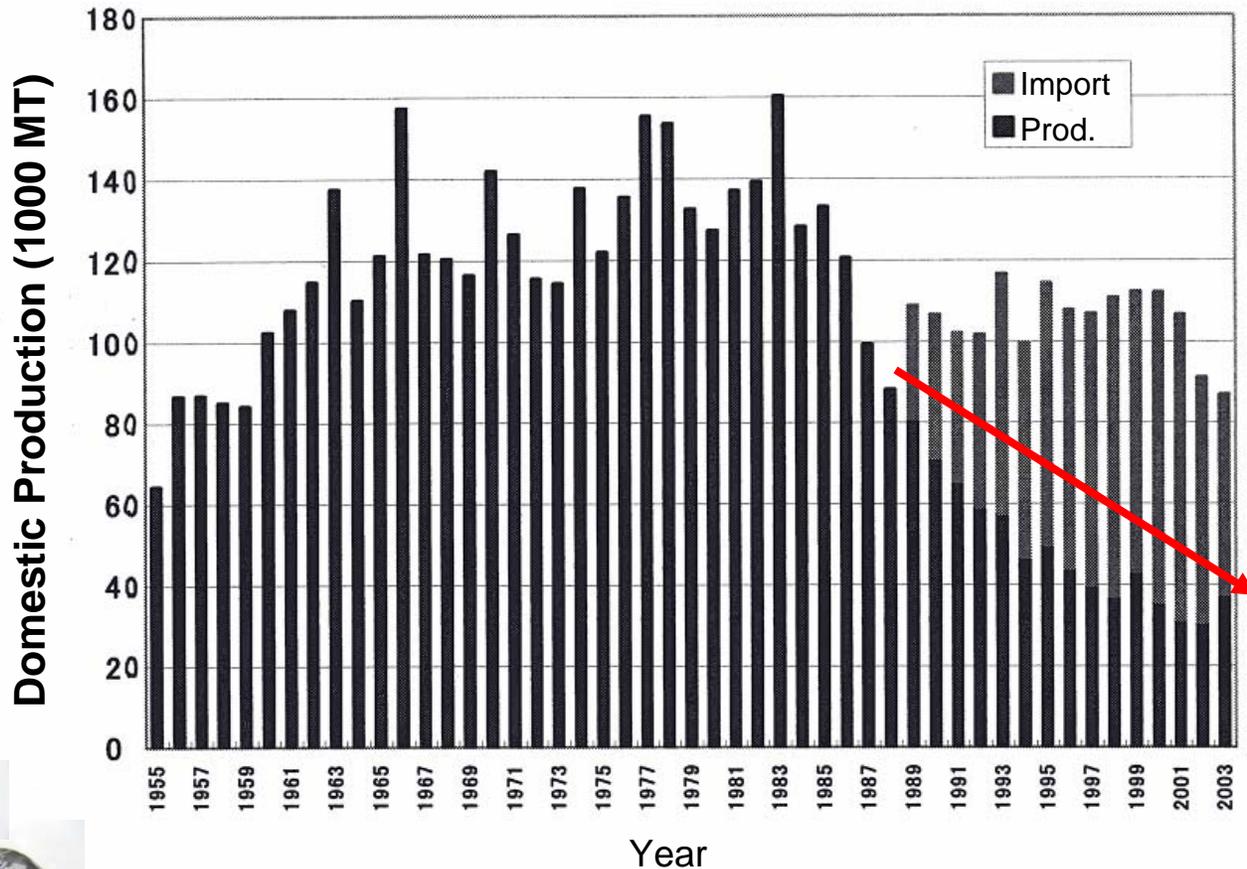
Asari rice



Steamed Asari

## Research Background 2 (Decline in Short-neck clam production)

### Short-neck clam production in Japan (1955-2003)

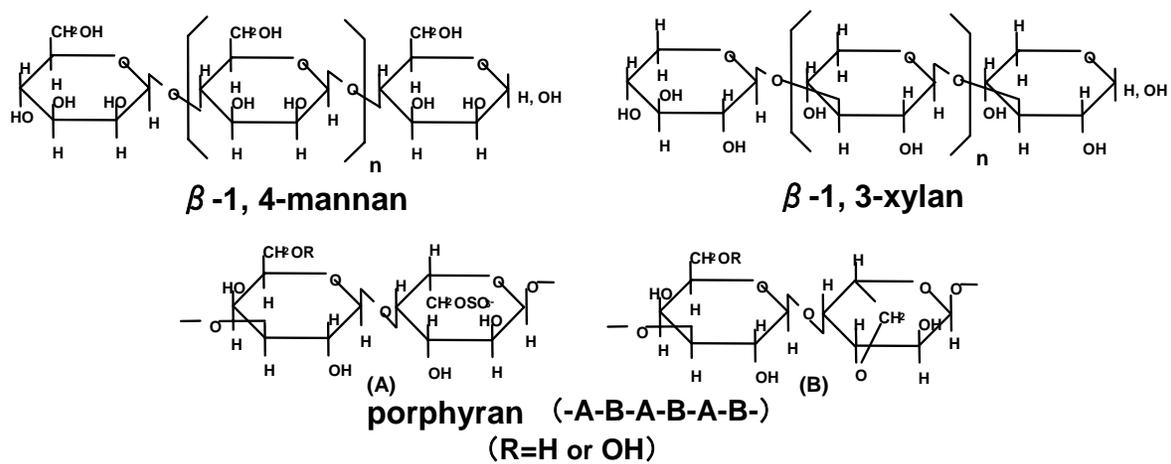
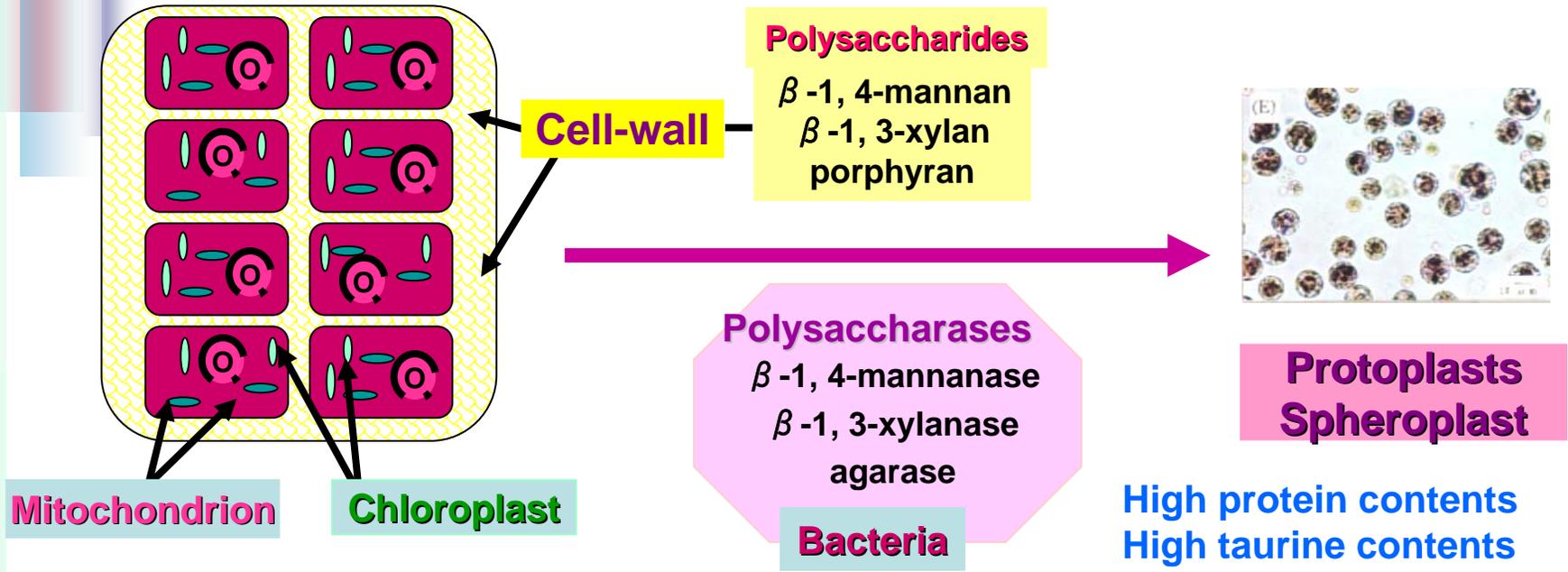


*Ruditapes philippinarum*

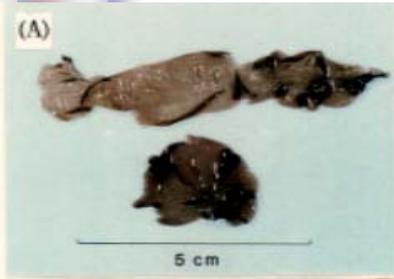


# [Materials and Method]

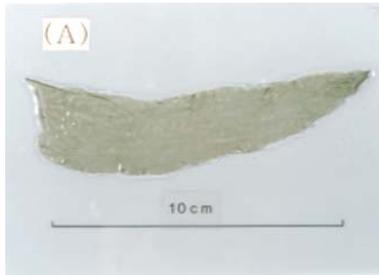
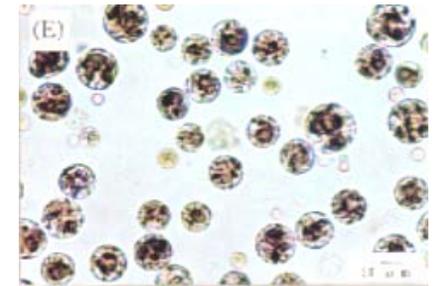
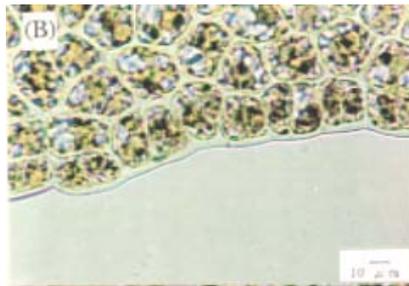
How to prepare single-cell materials from *Porphyra* spp.



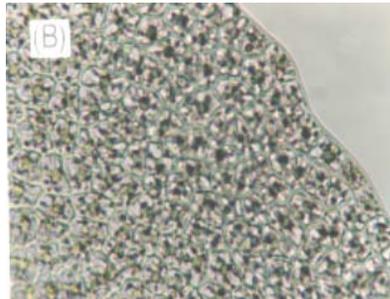
# Isolation of protoplasts from red algae



*Porphyra yezoensis*

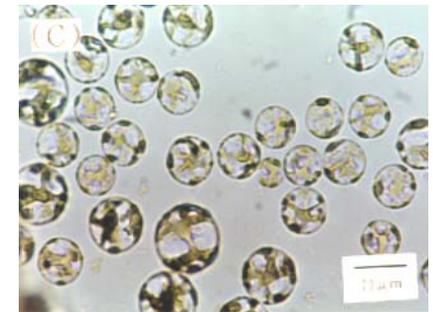


*Porphyra tenera*



$\beta$ -1,4-Mannanase  
from *Vibrio* sp.MA-138

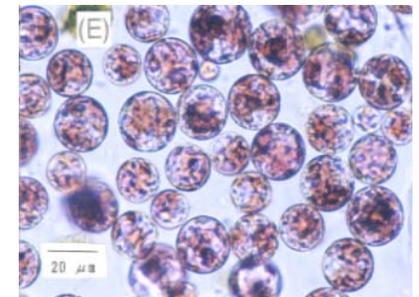
$\beta$ -1,3-Xylanase  
from *Alcaligenes* sp.XY-234



*Bangia atropurpurea*

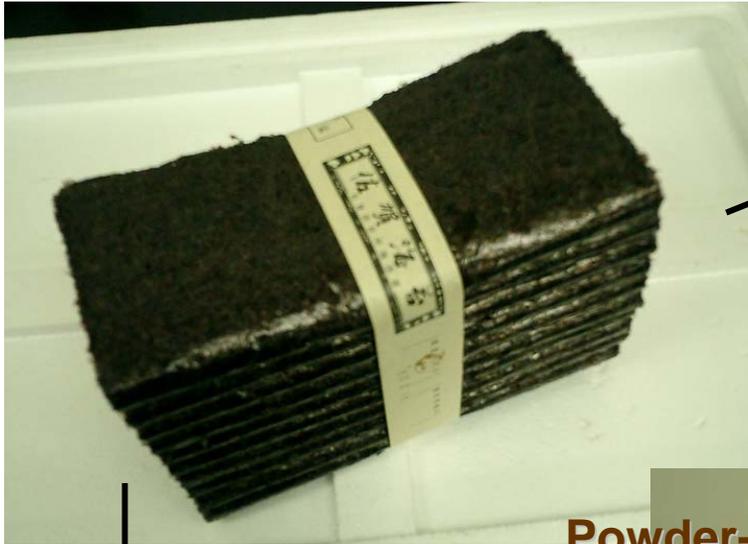


Agarase  
from *Vibrio* sp.PO-303



## [Materials and Method]

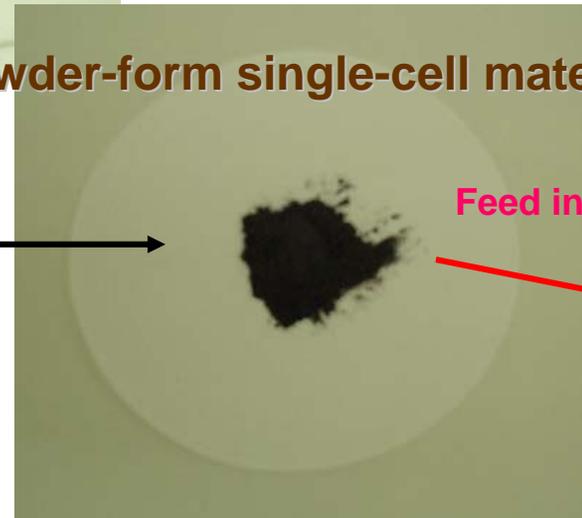
Sheets of low grade "Sushi-nori"



Sushi-rolls



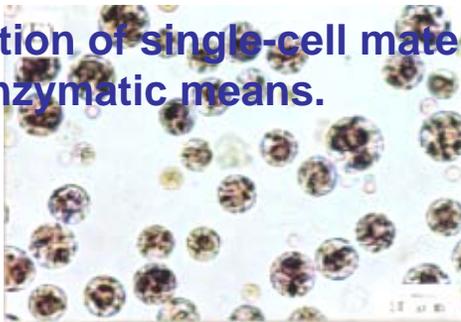
Powder-form single-cell material



Feed ingredient



Isolation of single-cell materials by enzymatic means.



<b>Nutrients</b>	Unit	<i>Porphyra</i>	Soy bean	Rice	Eel
Energy	kcal	189	477	416	673
Protein	g	43.0	40	6.3	45
Lipid	g	4.04	22	0.7	51
Carbohydrate	g	42.2	32	92	0.8
Ash	g	10.7	5.7	1.4	3.2
<b>Vitamins</b>					
A Retinol	mcg	0	0	0	6332
A Carotene	mcg	469	6.9	0	0
A Retinol Equiv.	mcg	7860	1.1	0	6332
D	mcg	0	0	0	47
E	mg	4.69	4.1	0	20
K	mcg	2838	21	0	0
B1	mg	1.32	0.9	0	1
B2	mg	2.93	0.3	0	1.3
Niacine	mg	12.9	2.5	0.5	7.9
B6	mg	0.665	0.6	0	0.3
B12	mcg	84.7	0	0	9.2
Folic acid	mcg	1310	263	7	37
Pantothenic acid	mg	1.02	1.7	0.6	5.7
C	mg	175	0	0	5.3
<b>Minerals</b>					
Na	mg	666	1.1	465	74
K	mg	3384	2171	72	230
Ca	mg	153	274	7	130
Mg	mg	371	251	16	20
P	mg	753	663	86	260
Fe	mg	11.7	11	0.2	0.5
Zn	mg	4.04	3.7	1.4	1.4
Cu	mg	0.677	1.1	0.2	0
Mn	mg	2.73	2.2	0.9	0



As you see in this table *Porphyra* is a very nutritious food source.

**Nutritional profile of *Porphyra***

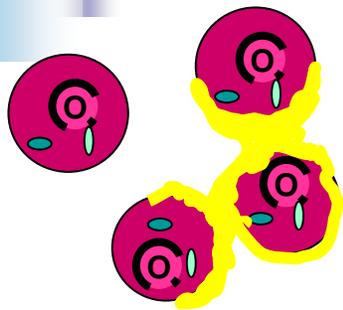
**[Materials and Method]****Table Proximate composition of single-cell *Porphyra***

	<b>Dried <i>Porphyra</i></b>	<b>Single-cell <i>Porphyra</i></b>
<b>Moisture</b>	<b>8.4 ± 0.5</b>	<b>5.9 ± 0.1</b>
<b>Crude Protein</b>	<b>29.1 ± 0.2</b>	<b>36.7 ± 0.7</b>
<b>Crude Lipid</b>	<b>0.1 ± 0.0</b>	<b>2.9 ± 0.2</b>
<b>Crude Ash</b>	<b>10.9 ± 0.1</b>	<b>3.5 ± 0.1</b>

Values are represented as mean ± SD (n=3)

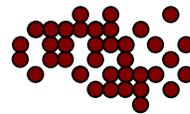
**Taurine content: 300-800 mg/100g**

## [ Experiment I-III ] Dietary value of single-cell *Porphyra* for clams



Single-cell material

Freeze-dry  
Spray-dry



Dietary Value

Short-neck clam  
(*Ruditapes philippinarum*)



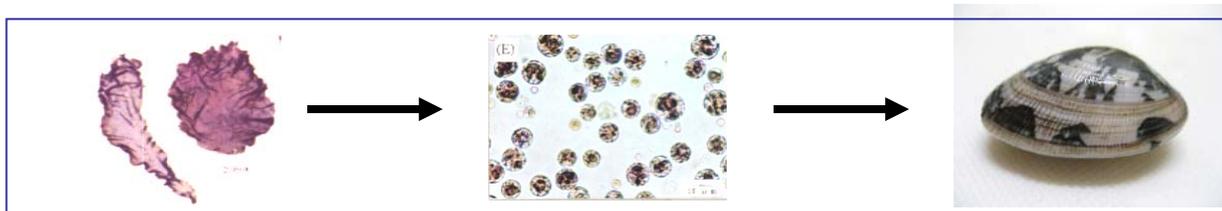
Spats (ca. 5 mm)  
Adults (ca. 30 mm)

Growth, Survival,  
Carcass composition  
Fatty acid composition  
etc.

Experiments II and III  
Other ingredients  
Lipid, Minerals, Vitamins, etc.

## [Results]

- No negative influence was observed in diets containing single-cell materials from *Porphyra* for short-neck clams.
- The SP diet showed almost same dietary value as natural diatoms for adult clams.
- By supplementing some other feed ingredients its dietary value was successfully enhanced .
- Optimum diameter for adult clams: 6.8-14.8  $\mu\text{m}$ .



As results, using single-cell *Porphyra* a new and high performance artificial diet for short-neck clams was developed. → Reduction of natural diatoms