

ALGAL BIOTECHNOLOGY

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Visit: phycolab.yolasite.com

DEFINITION

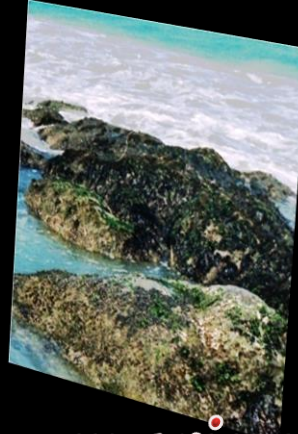
The term 'ALGAE' is an assemblage of chlorophyll bearing autotrophic, Photosynthetic Thallophytes whose cell wall is made of pure or mixed carbohydrates.

Distinguished based on the habitats for example:
FRESHWATER ALGAE AND MARINE ALGAE

AQUATIC ALGAE



Fresh water pond



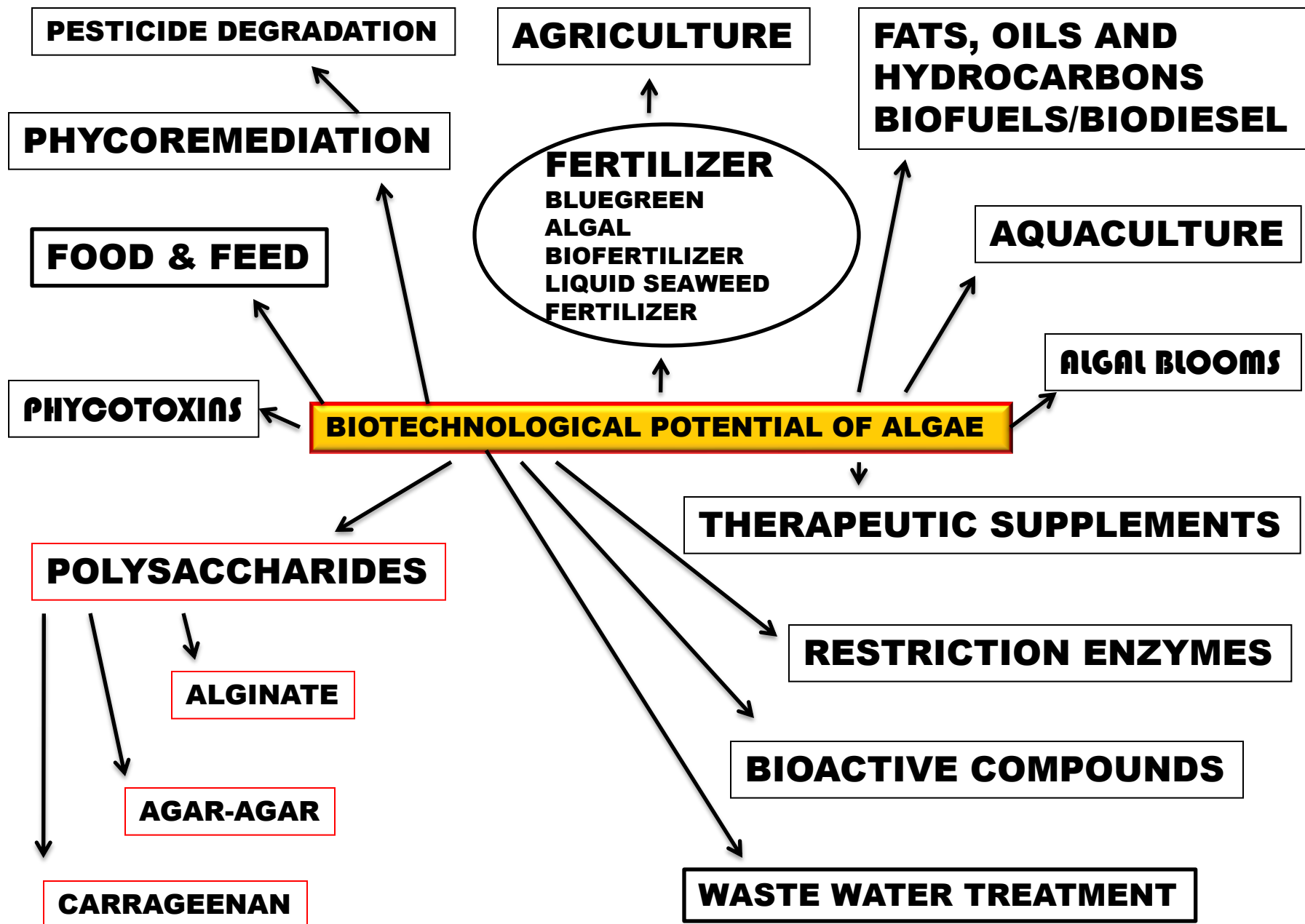
marine algae



Brackish water algae



marine algae



CYANOBACTERIAL BIOTECHNOLOGY

- **HEALTH FOOD & AQUA FEED**
- **PHYCOBILIPROTEINS**
- **PHYCOCYANIN**
- **CAROTENOID**
- **AMINOACIDS**
- **FATTY ACIDS**
- **RESTRICTION ENZYMES**
- **EXOCELLULAR POLYSACCHARIDES**
- **ISOTOPICALLY LABELLED METABOLITES**
- **BIOACTIVE COMPOUNDS**

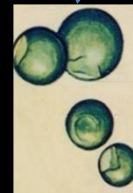
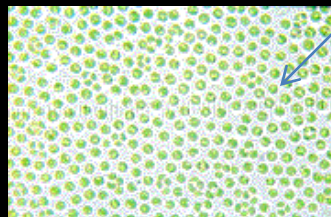
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- **THESE ARE OF COMMERCIAL VALUE AND AS PHARMACEUTICAL AGENTS**

- **LEVULENIC ACID,**
- **PALMITIC ACID,**
- **LINOLEIC ACID &**
- **OLEIC ACID**

- **FROM *SPIRULINA PLATENSIS* & *PHORMIDIUM***

NUTRIENT REMOVAL

- Phosphate removal by polyphosphate accumulating organisms and glycogen accumulating organisms.
- Nitrogen removal by *Nitrosomonas* which denitrify nitrite to nitrogen gas. Anaerobic ammonium oxidation is also important.
- Algae could absorb many nutrients and pollutants. *Dunaliella*, *Chlorella* and *Spirulina* are valuable species.



PHYCOREMEDIATION

Bacteria degrade organic matter in sewage.

**ALGAE USE NITROGEN
PRESENT IN SEWAGE**



SEWAGE TREATMENT WITH ALGAE

INITIATED ON 6TH MARCH



OBSERVED ON 2008 3 13

PROKARYOTES HELP RECYCLE CHEMICALS AND CLEAN UP THE ENVIRONMENT

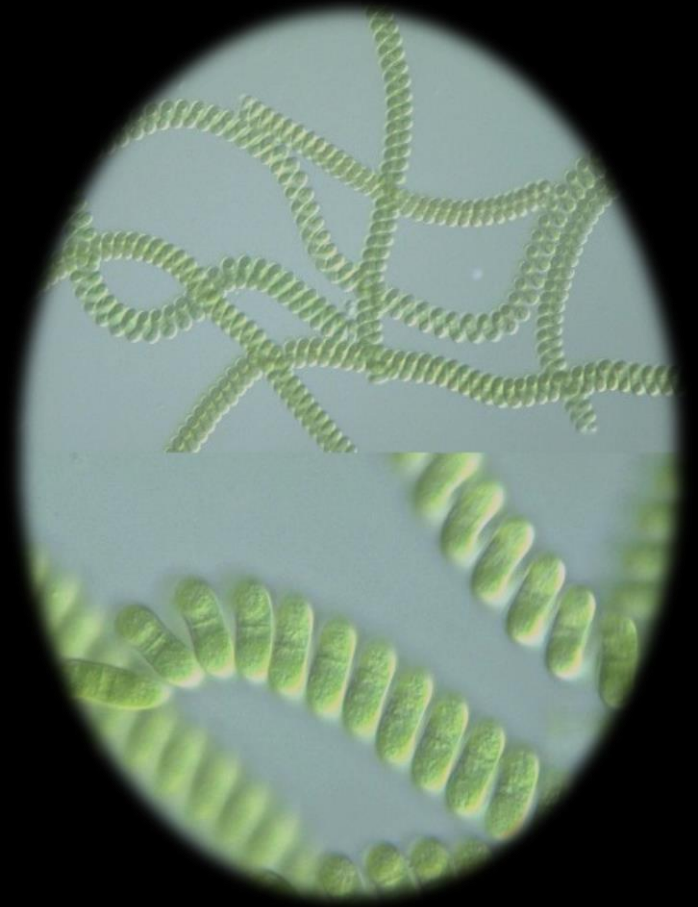


- **Cyanobacteria can convert nitrogen gas to nitrogen compounds plants can use**
- **Live on the roots of legumes and contribute nitrogen to the soil**
- **Breakdown of organic wastes and dead organisms to chemicals other organisms can use**
- **Decompose organic matter in sewage sludge to material that can be used as landfill or fertilizer**
- **“oil-eating” bacteria**
- **Accumulate metals from mine waters**

EXOCELLULAR POLYSACCHARIDE

- CYANOTHECE – METAL REMOVAL, FOOD AND PACKAGING INDUSTRIES.
- *COCCOCHLORIS ELABENS*, *ANABAENA sp.* & *PHORMIDIUM VALDERIANUM* Produce β -LACTAMASE
-
- β -LACTAMASE PERMITS ALGAE TO OVER COME THE INHIBITORY EFFECTS OF **PENICILLIN**. HENCE SIMILAR ALGAE CAN BE USED TO TREAT WASTE WATER CONTAINING TRACES OF ANTIBIOTICS, RELEASED FROM PHARMACEUTICAL INDUSTRIES.

Products developed at CFTRI, Mysore



SPIRULINA

COMPOSITION OF SPRAY-DRIED SPIRULINA

(CONSTITUENTS PER 100 GRAMS)

Major Consultants

Protein	65 – 71%
Fat	6.7%
Crude fibre	9.3%
Carbohydrates	16.0%
Calories	346

Vitamins

Beta – carotene	320.000 I.U
Biotin	0.22 mg
Cyanocobalamin (B ₁₂)	65.7 mcg
Folic acid	17.6 mcg
Other B-complex vitamins	9.2 mcg
Tocopherol (E)	0.73 I.U

Minerals

Calcium	658 mg
Phosphorous	977 mg
Iron	47.7 mg
Sodium	796 mg
Potassium	1, 140 mg

Essential Amino Acids

Lysine	2.99%
Cystine	0.47%
Methionine	1.38%
Phenylalanine	2.87%
Threonine	3.04%



Biochemicals and Other products

- ☞ **Pigments ***
- ☞ **Fatty Acids**
- ☞ **Polysaccharides**
- ☞ **Sterols**
- ☞ **Bioflocculants**
- ☞ **Vitamins**
- ☞ **Bio active compound**
- ☞ **Enzymes**
- ☞ **Cytotoxins**
- ☞ **Biosurfactants**

*** Beta-carotene, Astoxanthin, Phycocyanin**

SPIRULINA

- *Supports Health Immune System*
- *Supports Normal Cholesterol*
- *Boosts Energy & Cellular Health*
- *Pesticide / herbicide Free*
- *Over 60% Veg. Proteins Digested*
- *Rich Source of Polynutrients Especially Phycocyanin & Polysaccharides*
- *Food Source of GLA*
- *High B₁₂ – B Complex & Easy to Absorb iron*



SEAWEED SALAD



EUCHEUMA SALAD

JELLIES MADE USING AGAR-AGAR



GREEN PEAS PUDDING



FANTASY SEASCAPE JELLY



LAYER MADE WITH AGAR



COCONUT AGAR JELLY

LUK CHUK



SEAGRAPE JELLY



Jigir thanda prepared in Madurai is very similar to this one, but the raw material is *Gracilartia*

Carbon dioxide (CO₂): a “pollutant”?

- AIT introduces CO₂ with a picture like this (pp. 24-25). The black stuff is steam, not smoke, and CO₂ is as invisible as oxygen.



- AIT never mentions that CO₂ is plant food, an aerial fertilizer.
- Rising CO₂ levels help trees, crops, and green things generally grow faster and larger, produce more fruit, use water more efficiently, and resist pollution stress.
- Experimental data indicate that the 100-ppm increase in CO₂ levels since pre-industrial times has increased average yields by 60% for wheat, 33% for fruits and melons, and 51% for vegetables. An extraordinary positive externality, courtesy of the Industrial Revolution!

Absorbing atmospheric CO₂



- **Diatoms are unicellular and very abundant in freshwater and marine environments. Important food source for marine animals**

BIOFUELS



- **Renewable energy and resources:** engineering plants for the production of clean energy, biofuel, biomass, and animals for food production, etc.

Oil Yield per acre per year of algae is very high compared to various oilseed crops:

Algae 5000 - 15000 gallons/acre

Oil Palm	635 gallons/acre
Coconut	287 gallons/acre
Jatropha	207 gallons/acre
Rapeseed/Canola	127 gallons./acre
Peanut	113 gallons/acre
Sunflower	102 gallons/acre
Safflower	83 gallons/acre
Soybean	48 gallons/acre
Hemp	39 gallons/acre
Corn	18 gallons/acre

Oil being released from *Botryococcus braunii*
from increased pressure.



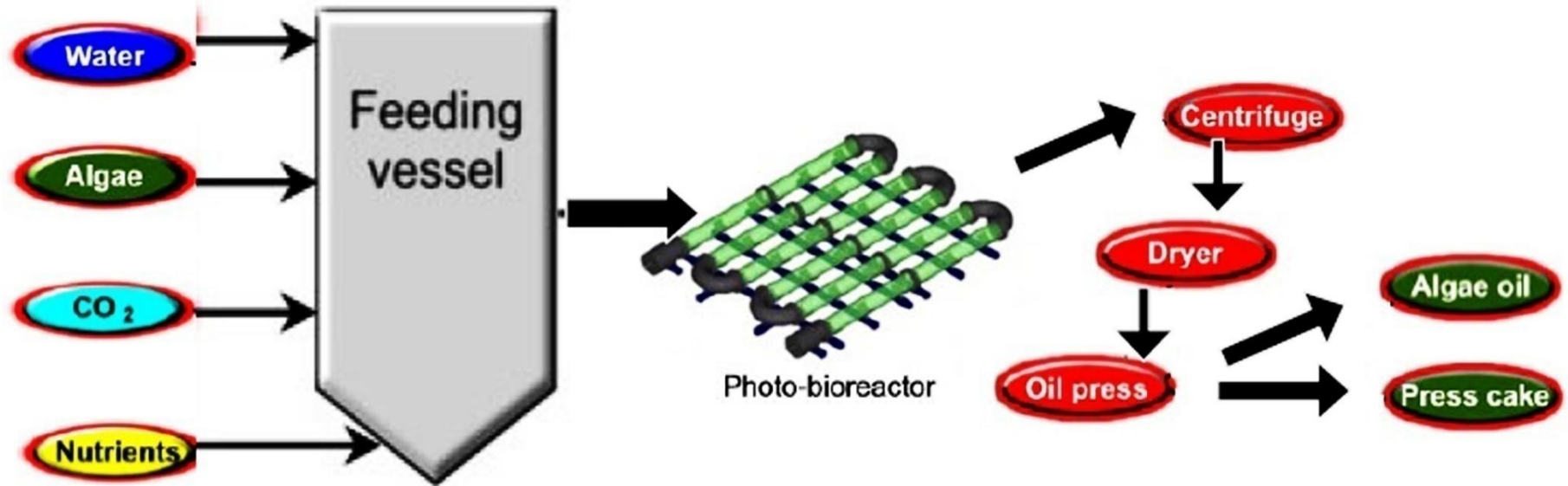
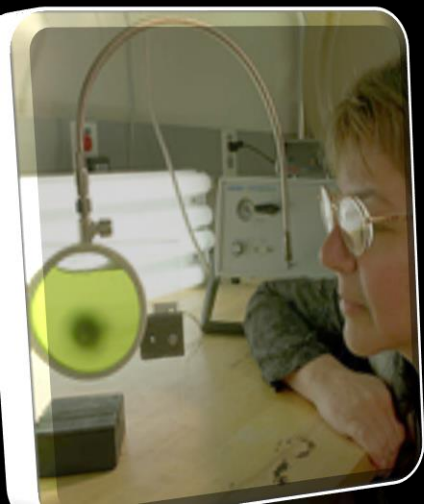


Photo-Bioreactor Unit Capabilities & Uses

- Test a variety of algal species and/or strains
- Test growth parameters for algae
- Grow algal mass
- Dry algae
- Press oil out of the algae and
- Process waste for fermentation & ethanol production

A JOURNEY FOREVER?

- Various bacteria and algae, for example *Escherichia coli*, *Enterobacter aerogenes*, *Clostridium butyricum*, *Clostridium acetobutylicum*, and *Clostridium perfringens* have been found to be active in **hydrogen production** under anaerobic conditions.
- The most effective H₂ production is observed upon fermentation of glucose in the presence of *Clostridium butyricum* (strain IFO 3847, 35 mmol h⁻¹ H₂ evolution by 1 g of the microorganism at 37°C).



BIOBASED POLYMERS

Directly extracted from Biomass

Classically synthesised from bio-derived monomers

Polymers produced directly by organisms

Polysaccharides

Proteins

Lipids

Polylactate

PHA

Starch

Potato

Maize

Wheat

Rice

Derivatives

Animals

Casein

Whey

Collagen/G
elatine

Plant

Zein

Soya

Gluten

Cross-linked
tri-glyceride

Other Polyesters

Bacterial
cellulose

Xanthan
Curdlan
Pullan

Cellulose

Cotton

Wood

Other
Derivatives

Gums

Guar

Locust bean

Alignates
Carrageenan

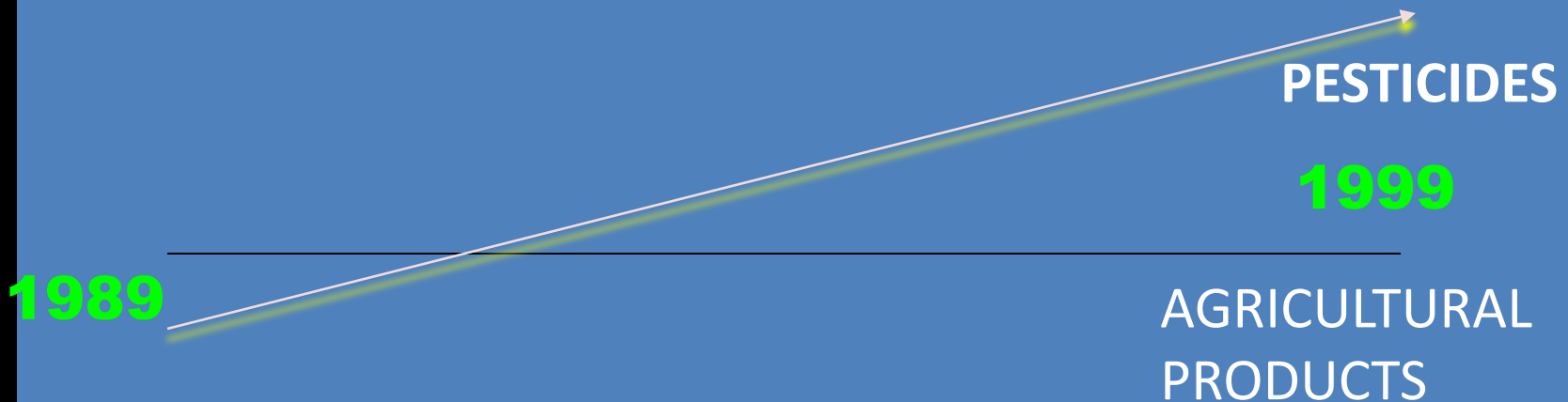
Pectins

Derivatives

Chitosan/Chitin

PROBLEM WITH IMPROPER USAGE OF PESTICIDES

- WHO - 1 million pesticide poisoning cases and 20,000 consequent deaths every year



NORMAL AND ABNORMAL SPERMS



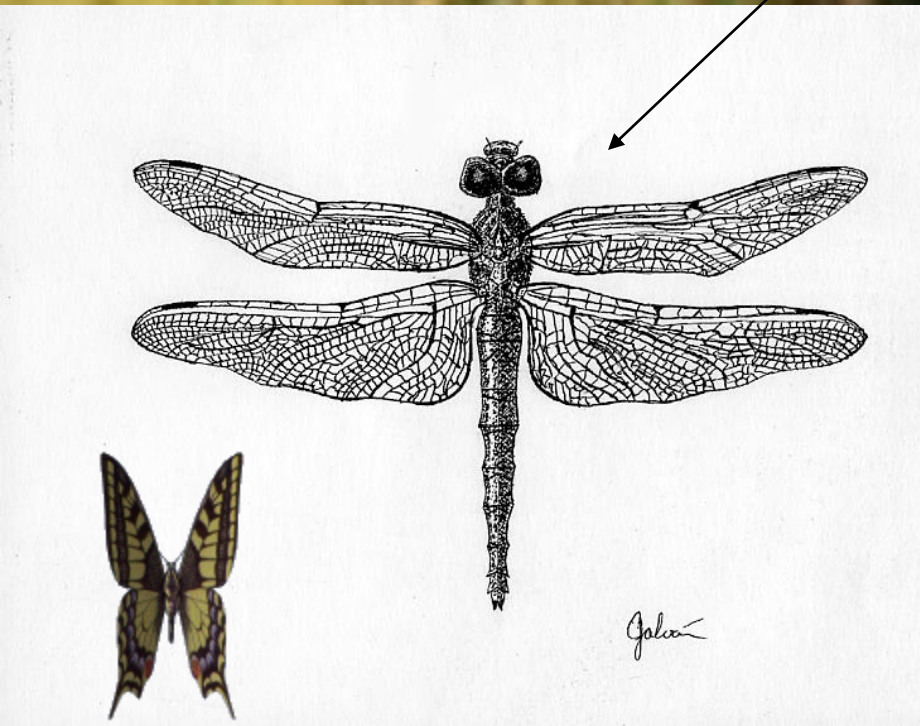
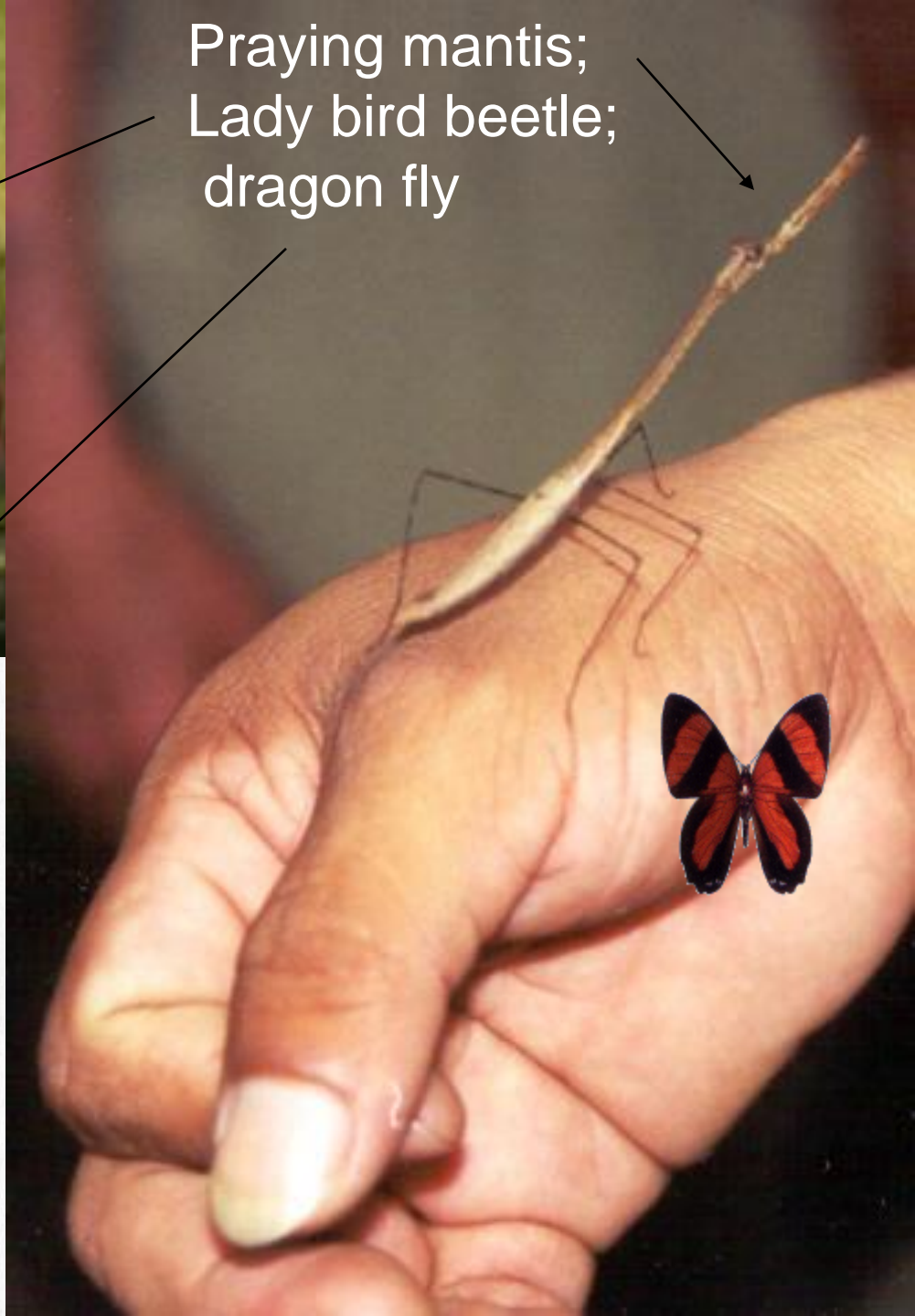
normálna oválna
forma spermii

abnormálny tvar spermii

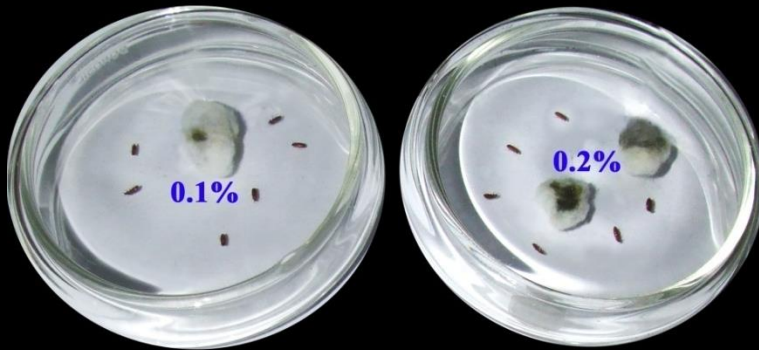




Praying mantis;
Lady bird beetle;
dragon fly



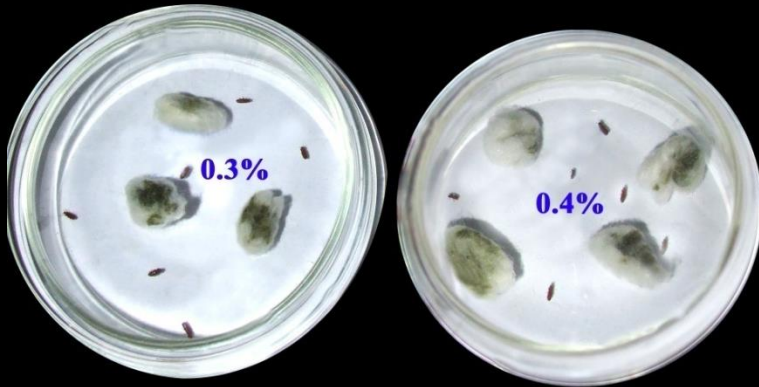
ALGAL PESTICIDE



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ACETONE EXTRACT - ALL 6 PESTS
DIED IN 2 HRS



3

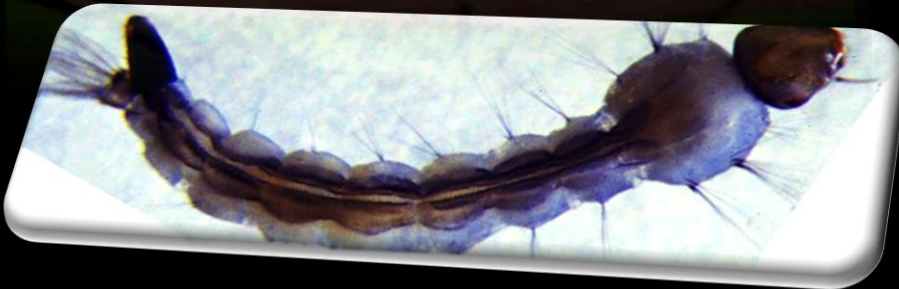
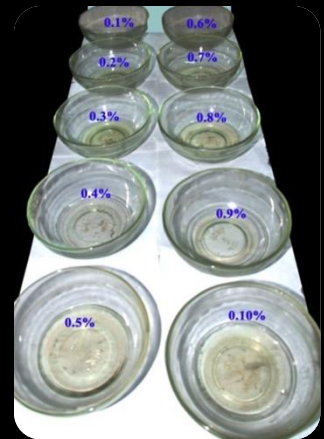
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Sitophilus oryzae treated with
Different concentrations of the
extract obtained from
Sargassum wightii.



MOSQUITO LARVICIDAL EFFECT OF MARINE ALGAE



**1% METHANOL EXTRACT-
ACANTHOPHORA SPICIFERA-
100% MORTALITY IN 10 MTS.**

Microbes that are pathogenic to insects are alternatives to chemical pesticides to prevent insect damage to agricultural crops and disease transmission.

Bacillus thuringiensis infections are fatal in many insects but harmless to other animals including humans and to plants.



**Bacterial
spores or
isolated
toxins are
already used
as an organic
insecticide**

ALGINIC ACID

**REPEATING UNITS OF
POLYMANNURONIC ACID
AND
POLYGULURONIC ACID
ARRANGED ALTERNATELY**

ALGINIC ACID

SOURCE:

**SPECIES OF --- *SARGASSUM*
TURBINARIA
CYSTOSEIRA
*LAMINARIA***



ALGINIC ACID-PROPERTIES:

**FORM REVERSIBLE GELS
WHICH CAN BE SET WHEN
EXPOSED TO CALCIUM OR
ACIDIFYING AGENTS.**

**INSOLUBLE IN WATER BUT THE
SALTS OF SODIUM, POTASSIUM
AND AMMONIUM ARE SOLUBLE
IN WATER**

ALGINIC ACID-USES

- **USED AS A STABILIZER IN ICE CREAM, FRUIT SQUASH AND CREAMS**
- **AS A FLOCCULANT AID IN WATER TREATMENT**
- **AS A CLARYFYING AGENT IN BEER PRODUCTION**
- **USED AS A THICKNER IN FOOD PREPARATION**
- **IT IS USED TO INCREASE THE VISCOSITY OF REACTIVE DYE SOLUTIONS IN TEXTILE PRINTING**
- **USED IN THE PRESERVATION OF MEAT, FISH AND POULTRY**
- **USED AS A CONSTITUENT IN THE MANUFACTURE OF FLAME PROOF FABRICS**
- **USED IN THE PREPARATION OF SPHERULES WITH SUSPENDED MICROBES IN CELL IMMOBILIZATION TECHNIQUES**
- **ALGINATES CAN BE MADE INTO FIBERS AND USED TO MAKE HIGH PERFORMANCE PAPER**

ALGINIC ACID-USES

PHARMACEUTICAL USES:

- ❑ ANTACID COMPOUND CONTAINING ALGINIC ACID REDUCES THE NUMBER OF HEART BURN ATTACKS**
- ❑ PREVENTS GASTROESOPHARENGEAL REFLUX WHICH RESULTS IN INFLAMMATION OF THE ESOPHARENGEAL MUCOSA ESPECIALLY IN ADULTS**
- ❑ ALGINATE DRESSINGS ARE USED TO PACK SINUSES, FISTULAS, BLEEDING TOOTH SOCKETS AND IN CONTROLLING NOSE BLEED**
- ❑ USED IN THE PREPARATION OF HAND LOTIONS, OINTMENTS, WET DRESSINGS, ARTIFICIAL TEARS AND IN WETTING AGENT FOR CONTACT LENS**
- ❑ SODIUM AND POTASSIUM SALTS ARE USED IN MAKING DENTAL IMPRESSION MATERIALS**

ALGINIC ACID-EXTRACTION

DRY SEAWEED

PRETREATMENT - WITH Dil. HCL & BOILING WATER

WASHING

MACERATION – WITH SODIUM CARBONATE (2-3%)

FILTRATION – USING A MUSLIN CLOTH

**DRYING OF FILTRATE – GIVES A VISCUS FLUID
OF CRUDE SODIUM ALGINATE**

**OR PRECIPITATE - WITH ALCOHOL → SODIUM
ALGINATE (PURE FORM)**

ALGINIC ACID-EXTRACTION

SARGASSUM



**AFTER 24 OVER
NIGHT TREATMENT**



**ALGA TREATED
WITH 2% SODIUM
CARBONATE**



SODIUM CARBONATE



**FILTRATION THROUGH
MUSLIN CLOTH**



**PRECIPITATION WITH
ETHANOL**

ALGINIC ACID-EXTRACTION

ALGINIC ACID:

**TREAT FILTERED VISCOUS FLUID WITH HCl (10%)
BLEACHING, WASHING AND DRYING OF THE
PRECIPITATE WILL GIVE → ALGINIC ACID**

CALCIUM ALGINATE:

**TREATMENT OF VISCOUS FLUID WITH
CALCIUM CHLORIDE PRECIPITATES →
CALCIUM ALGINATE**

SODIUM ALGINATE:

**CALCIUM ALGINATE + SODIUM CARBONATE/
SODIUM HYDROXIDE → SODIUM ALGINATE**

ALGINIC ACID-USES

Hollywood Impressions

Developed for customers by popular request from ArtMolds' dealers, Hollywood Impressions is a superior quality Dental Grade alginate with a set time of approximately 3 minutes.

Because of the rapid set time, this is the perfect choice for molds of baby's hands and feet as well as for creating dental prosthetics for special effects and taxidermy work.



ALGINIC ACID-USES

FiberGel E F/X Grade

E F/X Grade Alginate 40% STRONGER Set Time - 4-5 minutes
FiberGel - E F/X grade alginate is 40% stronger than any other alginate on the market. It is formulated for delayed shrinkage so casting is not immediate. Resists rips and tears like no other alginate because it contains a duo fiber matrix yet it provide the sharpest detail. Sets in approximately 4-5 minutes.



MoldGel - SloSet Alginate Set - 7-8 min

MoldGel - SloSet - alginate mixes easily into a smooth, creamy consistency providing forensic detail down to the fingerprints. SloSet gels in approximately 6-7-minutes. Its 3-to-1 (water to MoldGel) mix ratio means 1-lbs. (0.44 kgs.) of MoldGel yields 4-lbs. (1.8 kgs.) of high-coverage mold rubber. This is the right choice for larger applications such torso and faces



AGAR-AGAR

**COMPOSED OF ALTERNATING
UNITS OF
1,3- β -D-GALACTOSE
AND 1,4-LINKED ANHYDRO-L-
GALACTOSE**

AGAR-AGAR-SOURCE

***GRACILARIA* SPP.**

***GELIDIUM* SP.**

GELIDIELLA ACEROSA



AGAR-AGAR - PROPERTIES

**IT IS AN INERT SUBSTANCE THAT
HAS EXCELLENT GELLING
PROPERTIES AT MODERATE
TEMPERATURES**

AGAR-AGAR - USES

- ❖USED IN MAKING JELLIES**
- ❖IN THE PREPARATION OF CULTURE MEDIA FOR GROWING MICROBES**
- ❖USED AS A FOOD ADJUNCTS**
- ❖USED AS A SUBSTITUTE FOR GELATINE**
- ❖USED AS AN ANTIDRYING AGENT IN BREADS AND PASTRY**
- ❖USED IN IMPROVING SLICING QUALITY OF CHEESE**
- ❖IN THE MANUFACTURE OF FROZEN DAIRY PRODUCTS**

AGAR-AGAR - EXTRACTION



CLEANING-DRIED SAMPLE IS WASHED THOROUGHLY IN RUNNING FRESHWATER

EXTRACTION-BOILED IN WATER (30 TIMES OF THE SAMPLE) FOR 3 HOURS, MAINTAINING pH AT 6.8 WITH 1N H₂SO₄

FILTRATION-FILTER HOT THROUGH MUSLIN CLOTH - POUR IN TO A TRAY AND ALLOW TO FORM GEL- CUT IT IN TO STRIPS

FREEZING-KEEP THE TRAY WITH GEL STRIPS IN A DEEP FREEZER OVER NIGHT

THAWING-REMOVE THE FROZEN AGAR TO ROOM TEMPERATURE FOR 1 Hr AND DRAIN THE WATER

BLEACHING-BLEACH WITH 1% SODIUM HYPOCHLORITE SOLUTION FOR 5 MINUTES. TREAT BLEACHED MATERIAL WITH 2% SODIUM BI-SULPHITE SOLUTION FOR LESS THAN A MINUTE

DRYING-DRY IN THE SUN OR AT 60 DEGREE C IN A HOT AIR OVEN

AGAR-AGAR - INDUSTRY



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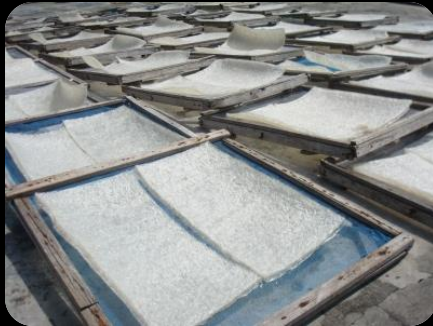
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4



8



7



6



5



9

AGAR-AGAR - USES

- ❖ USED AS A PRESERVATIVE FOR MEAT AND FISH IN TROPICAL REGIONS**
- ❖ USED IN SIZING OF PAPERS, WATER PROOFING OF PAPER AND CLOTH**
- ❖ USED IN THE PREPARATION OF PHOTOGRAPHIC FILMS, SHOE POLISH AND HAND LOTIONS**
- ❖ USED IN IMPARTING A GLOSS TO FINISHED LEATHER.**
- ❖ IN THE ELECTRICAL INDUSTRY AGAR IS USED IN MAKING A LUBRICANT FOR DRAWING HOT TUNGSTEN WIRE**
- ❖ AGAROSE-APURIFIED FORM OF AGAR USED IN GEL ELECTROPHORESIS**

CARRAGEENAN

**COMPOSED OF ALTERNATE UNITS
OF α -1-3 AND β -1-4 D-GALACTOSE
WITH SULPHATE**

CARRAGEENAN-SOURCE



HYPNEA



SARCONEMA FILIFORME



**KAPPAPHYCUS
ALVAREZII**



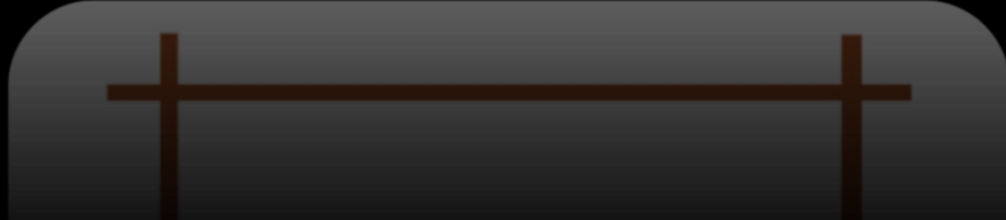
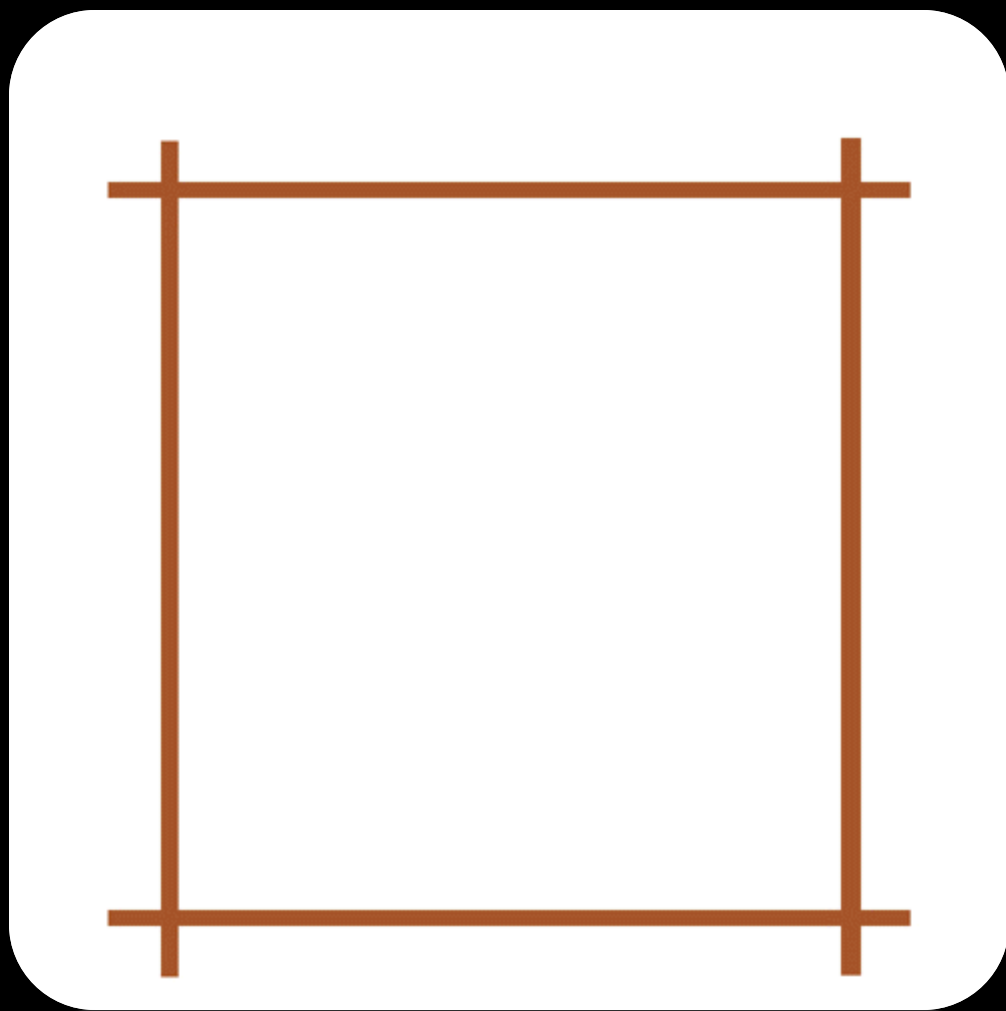
GRATELOUPIA



EUCHEUMA

KAPPAPHYCUS CULTIVATION





CARRAGEENAN-PROPERTIES

FORMS HIGHLY VISCOUS AQUEOUS SOLUTION

**FORMS GELS ON COOLING OF HOT SOLUTIONS
IN THE PRESCENCE OF CATIONS SUCH AS K/Ca.**

**FORMS GELS BY COOLING A SOLUTION OF
CARRAGEENAN IN HOT MILK**

CARRAGEENAN-EXTRACTION

CLEANING – TO REMOVE SAND & CALCAREOUS STONES

EXTRACTION – IN ALKALINE WATER (BY USING 2% SODIUM CARBONATE SOLUTION) MAINTAIN A TEMPERATURE OF 95 DEGREE C FOR 2 HRS.

FILTRATION – COOL AND FILTER THROUGH FINE CLOTH

CONCENTRATION – EVAPORATE *IN VACUO* TO REDUCE THE VOLUME TO HALF THE ORIGINAL VOLUME

PRECIPITATION – PRECIPITATED WITH ISOPROPANOL

DRYING – REMOVE THE PRECIPITATE AND DRY IN AN OVEN

GRINDING

PACKING

CARRAGEENAN-USES

IT IS USED FOR ITS PHYSICAL FUNCTIONS IN GELATION, VISCOUS BEHAVIOURS, STABILIZATION OF EMULSIONS, CONTROL OF CRYSTAL GROWTH, BINDING, DISPERSION AND SYNERESIS CONTROL.

USED AS A GELLING AGENT

USED AS A STABILIZING AGENT IN ICE CREAM, EVAPORATED MILK, INFANT FOOD FORMULAE AND IN SALAD DRESSINGS

CARRAGEENAN-USES

**IT STABILIZES AND THICKENS THE STERILIZED/
PASTEURIZED MILK DRINKS, YOGHURT,
BAKER'S JELLIES, ETC.**

**USED TO SUSPEND COCOA IN MILK AND WHIPPED
CREAM**

**USED TO MAKE ANTIBIOTIC ICE USED FOR FISH
PRESERVATION**

USED IN PROCESSING MEAT, FISH AND POULTRY

CARRAGEENAN-USES

**USED AS A STIFFENING AND BINDING MATERIAL
IN TEXTILE INDUSTRY**

USED IN THE PRODUCTION OF AIR FRESHNER GELS

**USED FOR PRODUCING GLOSS AND STIFFNESS IN
LEATHER**

**IN PHARMACEUTICALS IT IS USED AS AN ANTICOAGU-
LANT OF BLOOD IN VERY GREAT DILUTIONS.**

USEFUL AS A BINDER IN TOOTH PASTE

**ALSO USED AS A COMPONENT IN SHAVING SOAPS,
HAND LOTIONS AND HAIR CREAMS**

LIQUID SEAWEED FERTILIZER

IT IS EXTRACTED FROM SEAWEEDS

**IT CONTAINS UNIQUE COMBINATION OF N, P, K, TRACE
ELEMENTS, ALGINATES AND SIMPLE SUGARS IN
DISSOLVED FORM**

**THESE ARE EASILY ABSORBED THROUGH ROOTS AND LEAVES
BESIDES RELEASING TRACE ELEMENTS BOUND TO
THE SOIL**

**USED AS GROWTH STIMULANTS, DEFICIENCY CORRECTORS
AND ANTI-STRESS AGENTS**

**BIOZYME GRANULES: CYTOKININ AND AUXIN PRECURSORS
ENZYMES & HYDROLYSED PROTEIN
COMPLEXES**

LIQUID SEAWEED FERTILIZER

**COMMERCIALY AVAILABLE
LSFS.**

MAXICROP

ALGIFERT

GOEMAR GA 14

SEASPRAY

SEASOL

S.M.3.

CYTEX

SEA CROP 16

****Precursors- auxin & cytokinin.**

****Increase in shelf-life: fruits and vegetables.**

****Field trial-brinjal, papaya, citrus fruits.**



CHEMICAL CONSTITUENTS OF COMMERCIALLY AVAILABLE LSFs

S.NO.	CONSTITUENTS	MAXICROP	KELPAK 66
1.	MOISTSURE	5.2%	
2.	SOLKIDS	94.2%	
3.	ORGANIC MATTER	51.2%	
4.	ASH	43.6%	
5.	PROTEIN		3g
6.	CARBOHYDRATES		16.9g
7.	NITROGEN	0.72%	3.6g
8.	PHOSPHOROUS	2.0%	8.2g
9.	POTASSIUM	3.0%	7.2g
10.	BARIUM	---	1.9g
11.	BORON	1ppm	0.24mg
12.	CALCIUM	0.44%	800mg
13.	COBALT	4ppm	0.3mg
14.	COPPER	40ppm	0.2mg
15.	FLUORINE	---	0.4mg
16.	IODINE	0.9%	8.6mg
17.	IRON	0.34%	13.6mg
18.	MAGNESIUM	0.58%	200mg
19.	MANGANESE	40ppm	8.4mg
20.	MOLYBDENUM	10ppm	0.38mg
21.	NICKEL	24ppm	0.34mg
22.	SODIUM	18.9%	800mg
23.	STRONTIUM	---	0.4mg
24.	SULPHUR	6.1%	0.64mg
25.	ZINC	100ppm	4.2mg
26.	BISMUTH	0.8%	---

VITAMIN, CYTOKININS AND AMINO ACID CONTENT OF COMMERCIALLY AVAILABLE LSFs

S.NO.	CONSTITUENTS	KELPAK 66
1.	VITAMIN B ₁	0.08mg
2.	VITAMIN B ₂	0.08 mg
3.	VITAMIN C	20 mg
4.	VITAMIN E	0.68 mg
5.	GROWTH REGULATOR- CYTOKININS	0.031mg
6.	AMINO ACIDS- ALANINE	280mg
7.	VALINE	150mg
8.	GLYCINE	140mg
9.	ISOLEUCINE	92mg
10.	LEUCINE	180mg
11.	PROLINE	184mg
12.	THREONINE	152mg
13.	SERINE	208mg
14.	METHIONINE	72mg
15.	HYDROXYPROLINE	36mg
16.	PHENYLALANINE	8mg
17.	ASPARTIC ACID	316mg
18.	GLUTAMIC ACID	20mg
19.	TYROSINE	332mg
20.	ORNITHINE	20mg
21.	LYSINE	272mg
22.	ARGININE	16mg

MARINE GREEN ALGAE AND THE ELEMENTS PRESENT IN THEM

ALGAE	ELEMENTS	AUTHOR
CHLOROPHYCEAE		
<i>CHAETOMORPHA LINUM</i>	K, Na, Ca, Mg,	PILLAI, 1956
<i>ENTEROMORPHA</i>	Cl, Fe, Cu, Mn, B,	
<i>INTESTINALIS</i>	Mo, I & Zn	
<i>CLADOPHORA</i>	K, Na, Ca, Fe,	SITAKARA
<i>MONUMENTALIS</i>	Zn, B, Cl & SO₄	RAO, 1965
<i>CODIUM DWARKENSE</i>		
<i>ULVA LACTUCA</i>		
<i>ULVA RIGIDA</i>		
<i>CLADOPHORA</i>	N, P&C	WALLENTINU
<i>GLOMERATA</i>		S, 1981
<i>ULVA FASCIATA</i>	K, Na, Ca, Mg,	PAREKH AND
	Cl, SO₄ & PO₄	CHAUHAN,
		1982

MARINE BROWN ALGAE AND THE ELEMENTS PRESENT IN THEM

ALGAE	ELEMENTS	AUTHOR
PHAEOPHYCEAE		
<i>ROSENVINGEA INTRICATA</i> <i>PADINA AUSTRALIS</i>	K, Na, Ca, Mg, Cl, Fe, Cu, Mn, B, Mo, I & Zn	PILLAI, 1956
<i>COLPOMENIA SINUOSA</i> <i>CYSTOPHYLLUM SP.</i> <i>PADINA GYMNOSPORA</i> <i>SARGASSUM CENEREUM</i> <i>SARGASSUM JOHNSTONII</i>	K, Na, Ca, Fe, Zn, B, Cl & SO ₄	SITAKARA RAO, 1965
<i>NEREOCYSTIS LEUTKEANA</i>	K, Na, Ca, Mg, Sr, Al, Fe, Zn, Ba, Mn, Cr, Cu, NO ₃ , PO ₄ & Cl	WHYTE & ENGLAR, 1980
<i>FUCUS VESICULOSUS</i>	N, P, C	WALLENTINUS, 1981
<i>FUCUS SERRATUS</i> <i>LAMINARIA SACCHARINA</i>	N, P	KORNDFELDT RUTH-AIMEE, 1982
<i>SARGASSUM FILIPENDULA</i>	Zn, Pb, Cr, Co, Cu & Cd	DRUDE DE LACERDO <i>ET AL.</i> , 1985
<i>SACCHORHIZA POLYSCHIDES</i>	K, Na, N & C	JENSEN <i>ET AL.</i> , 1985

MARINE RED ALGAE AND THE ELEMENTS PRESENT IN THEM

ALGAE	ELEMENTS	AUTHOR
RHODOPHYCEAE		
<i>GRACILARIA LICHENOIDES</i>	K, Na, Ca, Mg, Cl, Fe, Cu,	PILLAI, 1958
<i>CHONDRIA DASYPHYLLA</i>	Mn, B, Mo, I & Zn	
<i>ACANTHOPHORA SPICIFERA</i>		
<i>LAURENCIA PAPILLOSA</i>		
<i>HYPNEA MUSCIFORMIS</i>		
<i>SARCONEMA FILIFORME</i>		
<i>SARCONEMA FUCELLATUM</i>		
<i>CEDRAMIUM TENUICORNE</i>	N, P, C	WALLENTINUS, 1981
<i>RHODOMELA CONFERVOIDES</i>	N & P	KORNFELDT RUTH- AIMEE, 1982
<i>POLYSIPHONIA NIGRESCENS</i>		
<i>CERAMIUM RUBRUM</i>		
<i>PHYCODYS RUBENS</i>		
<i>CHONDRUS CRISPUS</i>		
<i>FURCELLARIA LUMBRICALIS</i>		
<i>PHYLLOPHORA SPP.</i>		
<i>DICTYOPTERIS PLAGIOGRAMMA</i>	Zn, Pb, Cr, Co, Cu & Cl	DRUDE DE LACERDO ET AL., 1985
<i>GALAXAURA MARGINATA</i>		
<i>SPYRIDIA CLAVATA</i>		
<i>GRACILARIA CORTICATA</i>	K, Na, Ca, Mg, Cl & SO ₄	SITAKARA RAO, 1965
<i>GELIDIELLA ACEROSA</i>		

LIQUID SEAWEED FERTILIZER

RESPONSE OF PLANTS TO LSF

INCREASE IN YIELD, FRESH WEIGHT, DRY WEIGHT, SHOOT LENGTH, ROOT LENGTH, SEED YIELD, SEED MASS AND FRUIT MASS. SEED GERMINATION & MINERAL UPTAKE

IT'S USAGE WILL RESULT IN DISEASE RESISTANCE, FROST RESISTANCE. LONGER SHELF-LIFE OF FRUITS AND EARLY FLOWERING.

LIQUID SEAWEED FERTILIZER

EXTRACTION OF LSF

WASHING – IN WATER TO REMOVE ALL SUSPENDED IMPURITIES

DRYING – FIRST IN SUNLIGHT AND THEN IN HOT AIR OVEN AT 65 °C

GRINDING – PULVERISED IN A GRINDER TO OBTAIN A COARSE POWDER

SOAKING – IN WATER FOR A FEW MINUTES BEFORE EXTRACTION

EXTRACTION – COOK THE SEAWEED IN AUTOCLAVE OR PRESSURE COOKER FOR 2 HRS. IN WATER (10 TIMES OF THE MATERIAL

FILTRATION

CENTRIFUGATION – AT 5000-10,000 RPM TO REMOVE SUSPENDED IMPURITIES

DRYING – IN A HOT AIR OVEN AT 65°C. THICK VISCOUS FLUID GOT AT THE END IS STORED IN A SEALED BOTTLE WITH A PRESERVATIVE

OR

LIQUID SEAWEED FERTILIZER

EXTRACTION OF LSF

WASHING – IN WATER TO REMOVE ALL SUSPENDED IMPURITIES

DRYING – FIRST IN SUNLIGHT AND THEN IN HOT AIR OVEN AT 65 °C

GRINDING – PULVERISED IN A GRINDER TO OBTAIN A COARSE POWDER

SOAKING – IN WATER FOR A FEW MINUTES BEFORE EXTRACTION

EXTRACTION – COOK THE SEAWEED IN AUTOCLAVE OR PRESSURE COOKER FOR 2 HRS. IN WATER (10 TIMES OF THE MATERIAL

FILTRATION

CENTRIFUGATION – AT 5000-10,000 RPM TO REMOVE SUSPENDED IMPURITIES

DRYING – IN A HOT AIR OVEN AT 65°C. THICK VISCOUS FLUID GOT AT THE END IS STORED IN A SEALED BOTTLE WITH A PRESERVATIVE

OR

**DRY THE FILTRATE COMPLETELY AT 65°C , POWDER
AND PACK IN AIR-TIGHT BOTTLES**

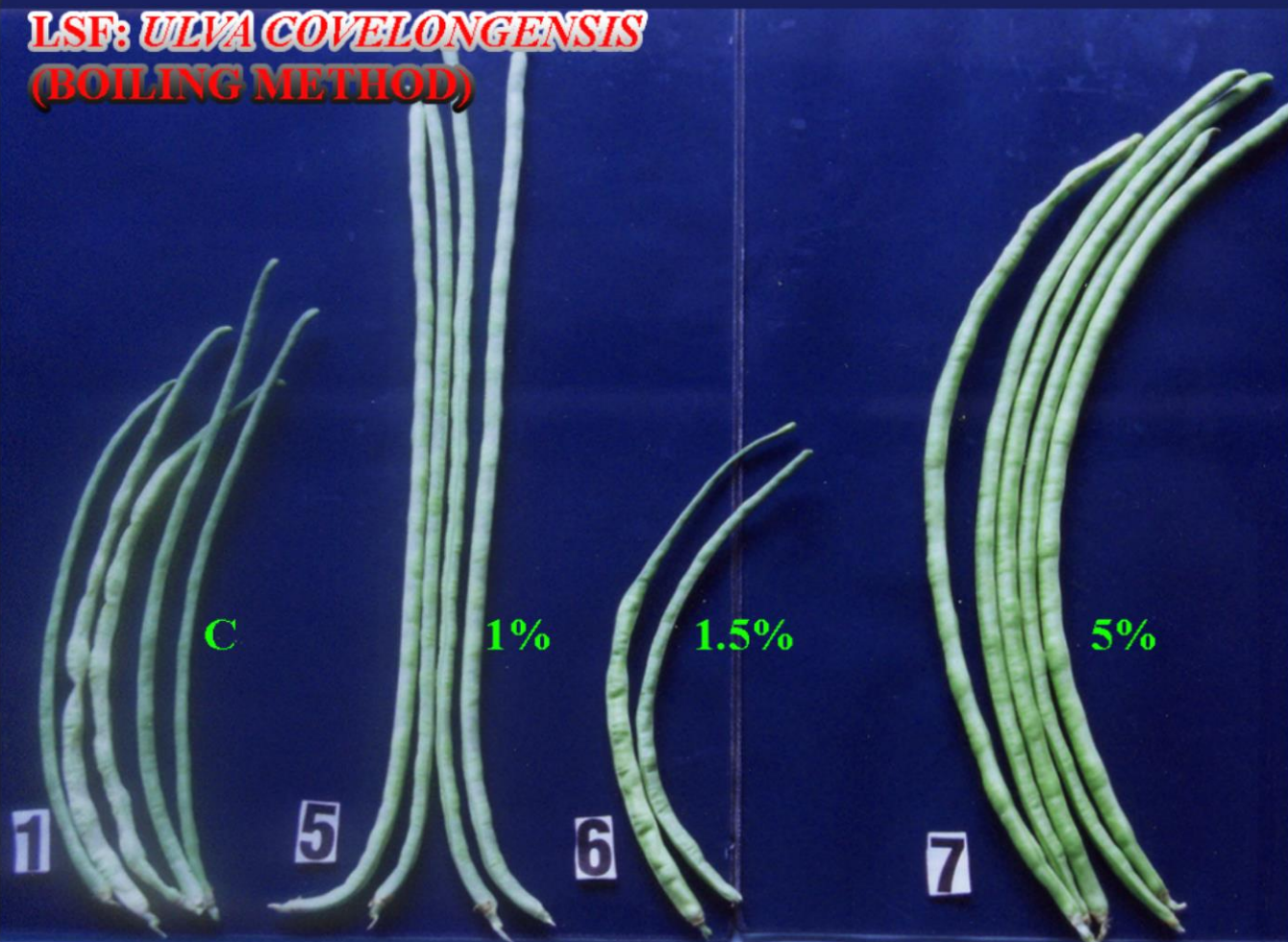
USAGE – 0.5 TO 1.0% SOLUTION IS PREPARED AND USED AS LSF

Effect of LSF from *Ulva covelongensis* on cow pea



Effect of LSF from *Ulva covelongensis* on cow pea

**LSF: *ULVA COVELONGENSIS*
(BOILING METHOD)**



RESTRICTION ENZYMES

- BLUE-GREEN ALGAE ARE VITAL SOURCE OF RESTRICTION ENZYMES
- Eg. Ava II – *NOSTOC sp.* PCC 7118 –
 - G GCC
- Asu I – *ANABAENA sp.* PCC 6309 –
 - G GNCC
- Many of these are cloned and expressed in *E.coli.*

ISOTOPICALLY LABELLED METABOLITES

- ***AGMENELLUM, ANACYSTIS & SPIRULINA ARE CAPABLE OF GROWING AT HIGH CELL DENSITY***
- ***THESE ARE GROWN ON SUBSTRATES SUCH AS CO₂ ENRICHED WITH ¹³C & ¹⁴C. THE RESULTING LABELLED COMPOUNDS UPON PURIFICATIONS CAN BE UTILIZED AS TRACERS IN BIOLOGY, MEDICINE, MEDICAL DIAGNOSIS AND ANALYTIC CHEMISTRY.***
- ***Eg. ²H, ³H, ¹³C, ¹⁴C AND ¹⁵N – LABELLED SUGARS, LIPIDS, L-AMINOACIDS & PROTEIN FRACTIONS.***

BIOACTIVE COMPOUNDS

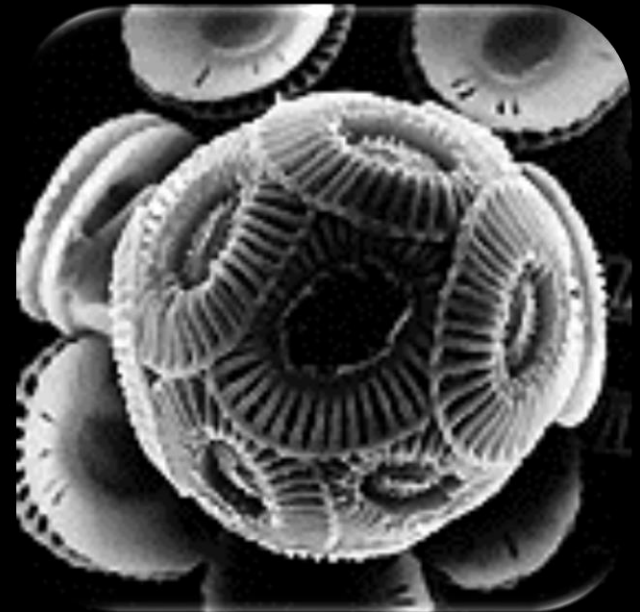
- ALGAE OF BOTH FRESH WATER AND MARINE ENVIRONMENT PRODUCE SUBSTANCES THAT ARE ACTIVE AGAINST A WIDE VARIETY OF MICROBES CAUSING DISEASES IN HUMANS, ANIMALS AND PLANTS.



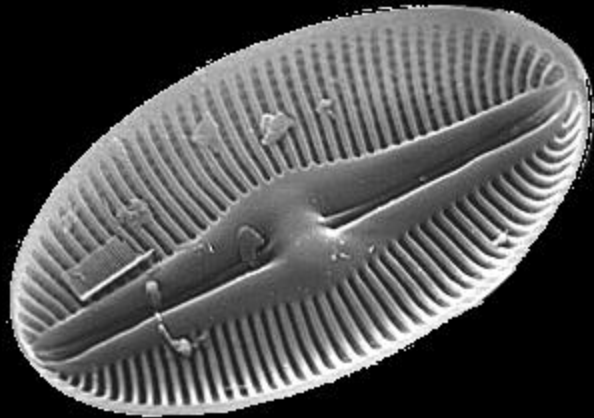
BENZENE EXTRACT OF ULVA FASCIATA, ETHANOL AND BENZENE EXTRACTS OF ACANTHOPHORA SPICIFERA, N-BUTYL EXTRACT OF SARGASSUM WIGHTII AND METHANOL EXTRACT OF PADINA TETRA-STROMATICA ARE OBSERVED TO BE VERY ACTIVE AGAINST A VARIETY OF HUMAN PATHOGENS

MAJOR CAUSE OF
GLOBAL WARMING IS
INCREASED CO₂ IN THE
ATMOSPHERE

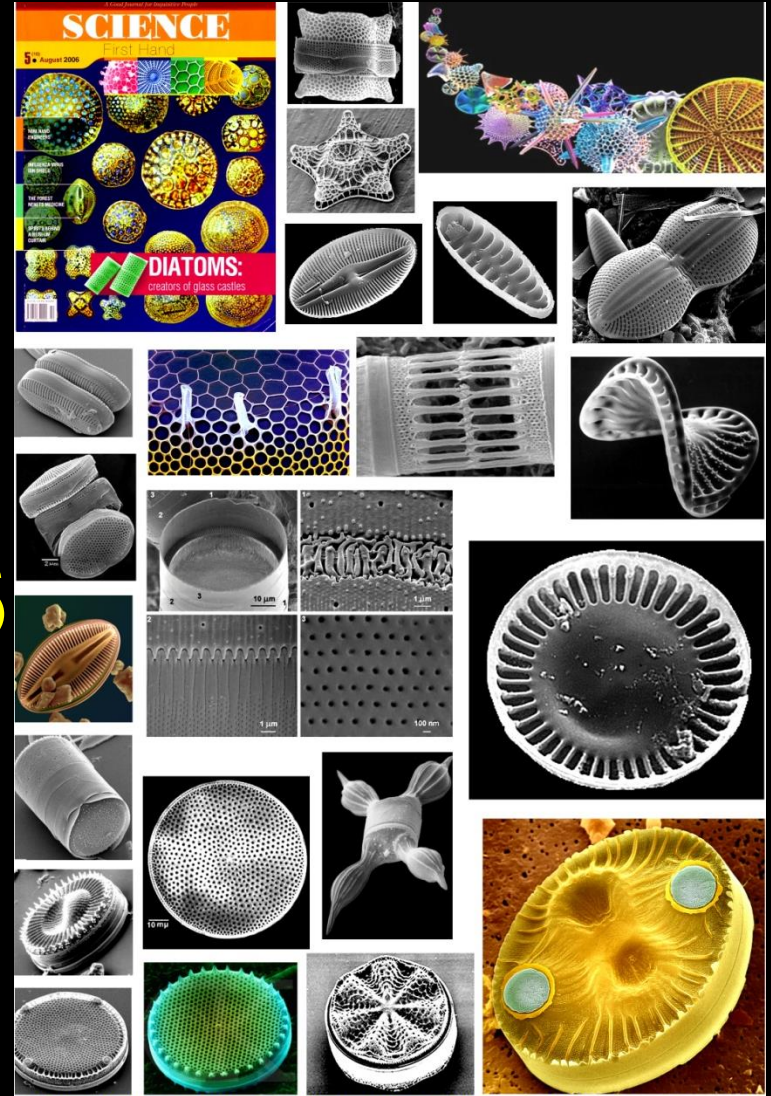
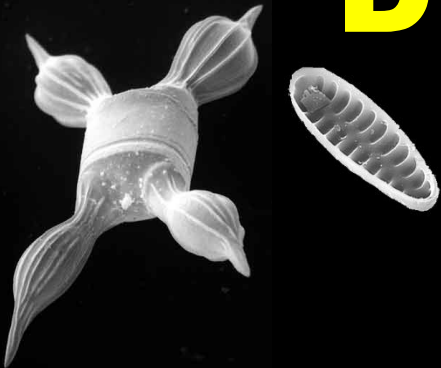
THIS CAN BE REDUCED
BY FAST GROWING ALGAE
THAT DEPOSIT CaCO₃ IN
IN THEIR CELL WALL.
THE ALGAE WHEN DIE
TAKE CaCO₃ TO OCEAN BOTOM.
THEREBY REDUCE THE CO₂ IN THE
ATMOSPHERE



NANOTECHNOLOGY



DIATOMS

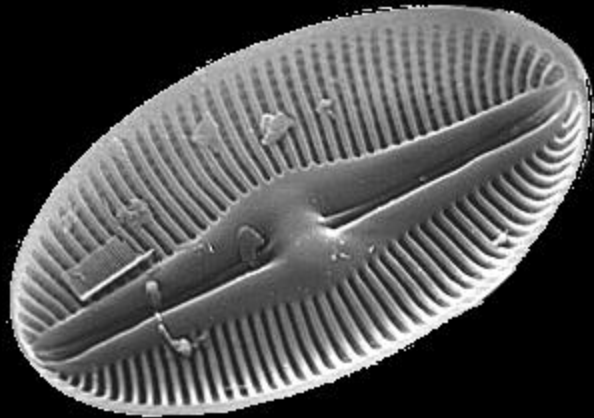


NANOPOROUS, NANOCRYSTALLINE SILICON MATERIAL OF CELL WALLS OF DIATOMS THAT CAN BE USED AS SEMICONDUCTOR SILICON, GAS SENSORS, BATTERY ELECTRODES AND AS CHEMICAL PURIFIERS

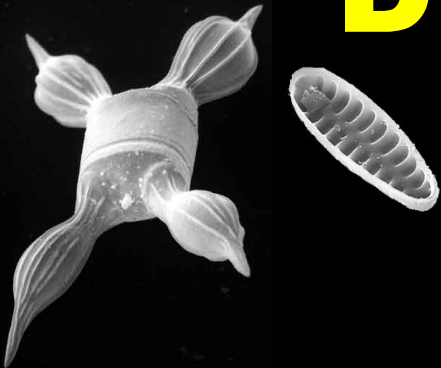


RUTGERS UNIVERSITY
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DIATOMS



NANOPOROUS, NANOCRYSTALLINE SILICON MATERIAL OF CELL WALLS OF DIATOMS THAT CAN BE USED AS SEMICONDUCTOR SILICON, GAS SENSORS, BATTERY ELECTRODES AND AS CHEMICAL PURIFIERS

THANK YOU

Dr. M. Baluswami

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