food algae production

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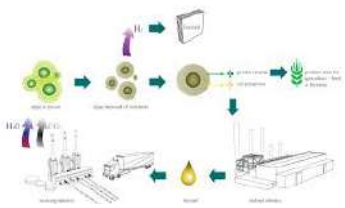
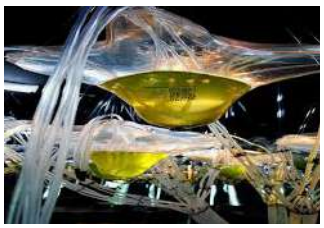
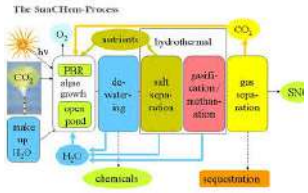


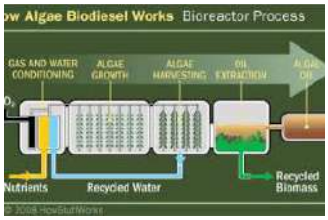



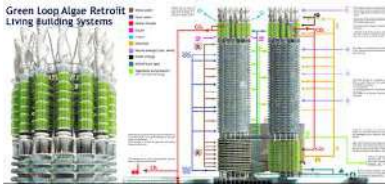




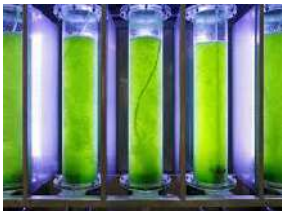


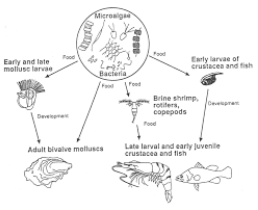






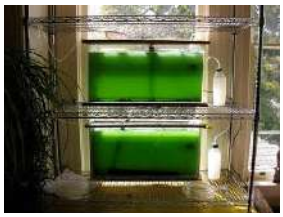


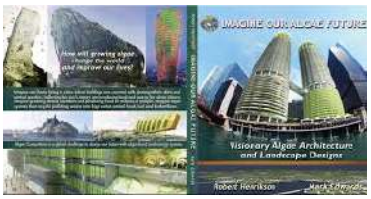








Algae in Products Today

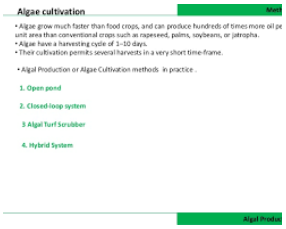
Previews of Algae Food Development and Recipes
Korean Style Algae Pancake


Green Jet Fu

IMAGINE OUR ALGAE FUTURE
How will growing algae change the world and improve our lives?
Visionary Algae Architecture and Landscape Designs
Robert Henrikson


SKYLINE
SKYLINE
SKYLINE

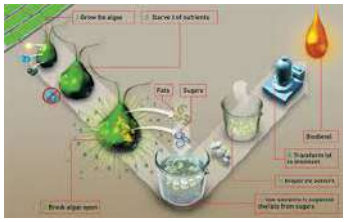

Detailed Parts List

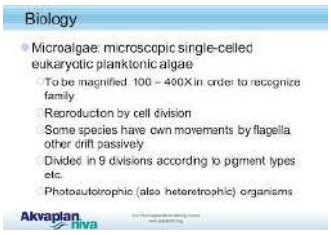
BIOFUELS
10



Algae cultivation
• Algae grow much faster than food crops, and can produce hundreds of times more oil per unit area than conventional crops such as rapeseed, palms, soybeans, or jatropha.
• Algae have a harvesting cycle of 1–10 days.
• Their cultivation permits several harvests in a very short time-frame.
• Algal Production or Algae Cultivation methods in practice .
1. Open pond
2. Closed-loop system
3 Algal Turf Scrubber
4. Hybrid System

Adaptability to a range of environment
Grown under conditions which are unsuitable for conventional crop production
(marine water, wastewater, open ponds)






Biology
Microalgae: microscopic single-celled eukaryotic planktonic algae
To be magnified 100 – 400X in order to recognize family
Reproduction by cell division
Some species have own movements by flagella other drift passively
Divided in 9 divisions according to pigment types etc.
Photoautotrophic (also heterotrophic) organisms
Akvaplan niva

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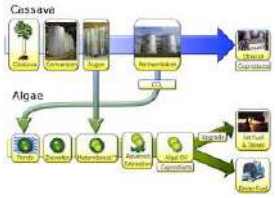
Indoor algae controlled cultivation using artificial lights

Cassava
Algae

Advantages of using algae for biofuel production

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Algae-to-Product Process
Algae Biorefinery
Oil
Biomass
Biofuel




DHA
Bigger fish, commercial source of fish oil
Micro-algae
Small fish
Phytoplankton
Zooplankton

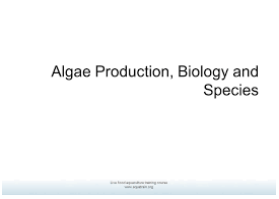

Algae

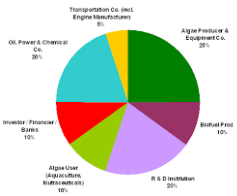

Main culture systems
Batch culture
300 or 500 litre sacs
D-ended tanks
Continuous culture
Connected sac system (SeaSalter)
Tubular fence (BioFence)
Tubular spiral (AddaVita)
heterotrophic production (Aqua Fauna)
Akvaplan


SeaSalter System
Continuous Algal Production Systems, SeaCAPS
Adapted batch culture technique
Plastic Sacs connected together
dosing pump water and nutrient supply
overflow into common collector


Future Food 1: Eating Down the Chain


Alltech
ALGAE

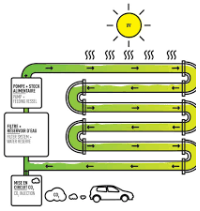

Algae Production, Biology and Species

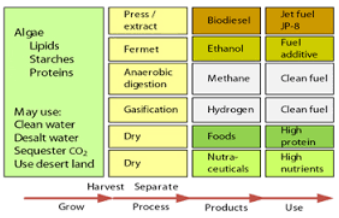



RESILIENCE & REGENERATION
LIVING FUTURE 13
MAY 15-17, 2013 SEATTLE, WA


Manual on the production and use of live food for aquaculture


Spirulina greenhouse pond in Normandy, France at Eco-Domaine Ferme de Bouguelot




Algae
Lipids
Starches
Proteins
May use:
Clean water
Desalt water
Sequester CO_2
Use desert land
Press / extract
Biodiesel
Jet fuel JP-8
Fermet
Ethanol
Fuel additive
Anaerobic digestion
Methane
Clean fuel
Gasification
Hydrogen
Clean fuel
Dry
Foods
High protein
Dry
Nutra-ceuticals
High nutrients
Harvest
Separate
Grow
Process
Products
Use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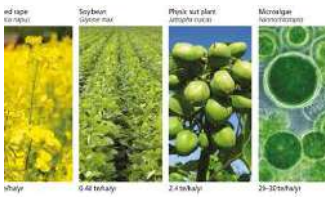
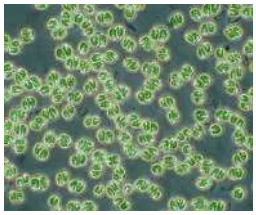
Algae Oil yield Compared to other Feedstocks
Comparative Yields
Soy Bean 50-65 Gallons Per Acre Per Year
Camelina 150-400 Gallons Per Acre Per Year
Palm 400-700 Gallons Per Acre Per Year
Algae 2,000 to 20,000+ 77 Gallons Per Acre Per Year




Algae in Products Today




EXPANDING THE
ALGAE
FOOD LANDSCAPE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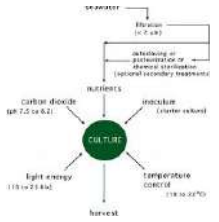
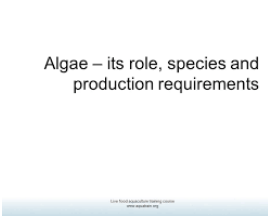
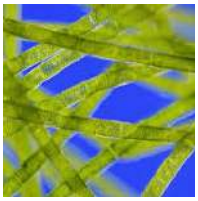
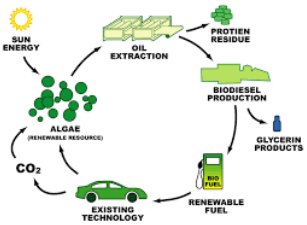

CULTURE

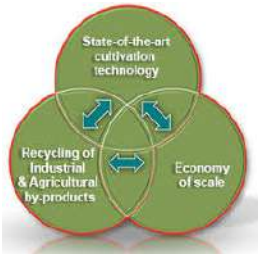

Algae – its role, species and production requirements


bug's PROTEIN




SUN ENERGY
OIL EXTRACTION
PROTIEN RESIDUE
BIODIESEL PRODUCTION
GLYCERIN PRODUCTS
ALGAE
(RENEWABLE RESOURCE)
CO2
EXISTING TECHNOLOGY
RENEWABLE FUEL


Commercial Uses of Algae
NUS
Cosmetics
Pharmaceuticals
Vitamins
Biofuel
Food
Bioplastics
Feedstock
Animal feed
Fertilizer/nutrients


State-of-the-art cultivation technology
Recycling of Industrial & Agricultural by-products
Economy of scale

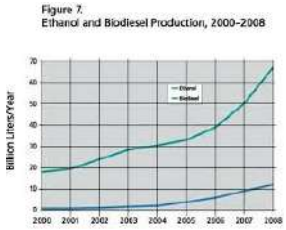
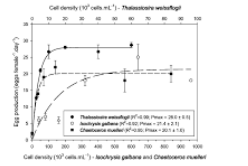
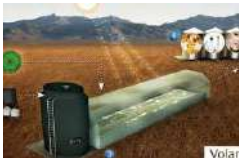
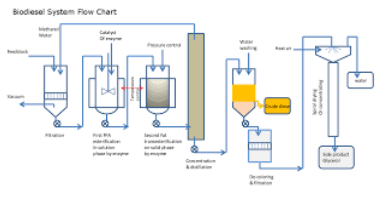


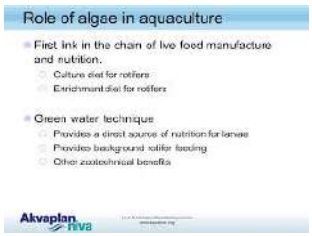
Figure 7.
Ethanol and Biodiesel Production, 2000-2008
Billion Liters/Year
2000 2001 2002 2003 2004 2005 2006 2007 2008


Diversified food sources
Algae
Insects
Edible plants not currently used for food



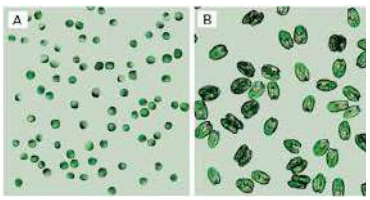

Volar


Biodiesel System Flow Chart


Role of algae in aquaculture
First link in the chain of live food manufacture and nutrition.
Culture diet for rotifers
Enrichment diet for rotifers
Green water technique
Provides a direct source of nutrition for larvae
Provides background rotifer feeding
Other zootechnical benefits
Akvaplan niva





PRODUCTION PROCESS

A
B


Algae as human food
Annual value is about US$6 billion
Main market and production area is Asia
"Mariculture" has become very important
Main high-value species are 'Nori', 'Kombu' and 'Wakame' (Porphyra, Laminaria and Undaria)
Mainly used as a subsidiary food adding relish, taste and 'feel' to food
European and North American market presently very small but has potential

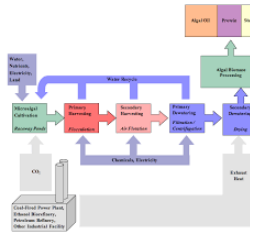


THE BRUNEI TIMES

The Future of Farming







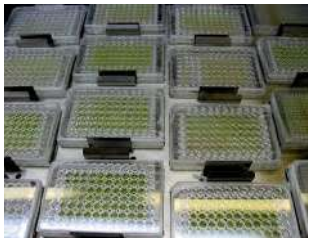


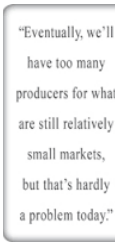


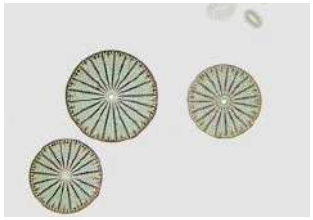
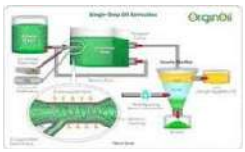
Uses of Seaweeds
Present
Food
Hydrocolloids and some chemical substances
Fertilizers
Potential
Source of energy/compost by digestion
Waste-water treatment

SARA Project



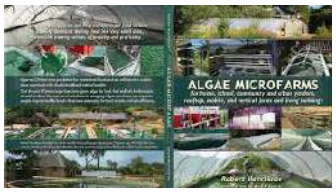

INTRODUCTION
Algae are simple organisms that typically produce their own food through photosynthesis.
The difficulties in efficient biodiesel production from algae lie in finding an algal strain with a high lipid content and a cost-effective cultivation system that is best suited to that strain.
There is also a need to provide concentrated CO2 to turbocharge the production.

"Eventually, we'll have too many producers for what are still relatively small markets, but that's hardly a problem today."

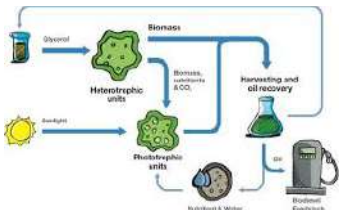



OrganOil


Why are algae important?
• Primary producers, basis of food webs, 'FORESTS/GRASSES OF THE SEA'
• Pioneer Species: on rocky shores, mudflats, hot springs, lichen communities, 'snow algae'
• O2 production and carbon fixation in aquatic habitats.
• Rare autotrophic organisms in extreme habitats.

2011 International Algae Competition




ALGAE MICROFARMS


How do you get oil from algae?

Biomass
Heterotrophic units
Harvesting and oil recovery
Photosynthetic units
Biodiesel

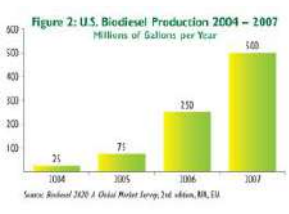
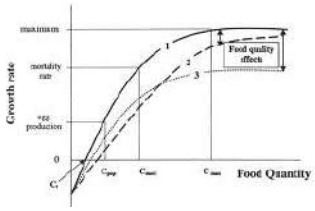



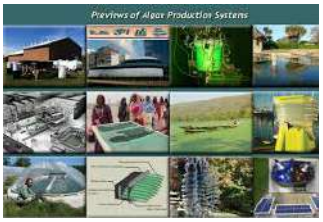
Figure 2: U.S. Biodiesel Production 2004 – 2007
Millions of Gallons per Year
25
75
250
500
2004
2005
2006
2007





Earthrise Nutritionals
Imperial Valley California
Cyanotech
Big Island Hawaii


Algaeh
ALGAE

maximum
mortality rate
Growth rate
Food quality effect
Food Quantity


Previews of Algae Production Systems



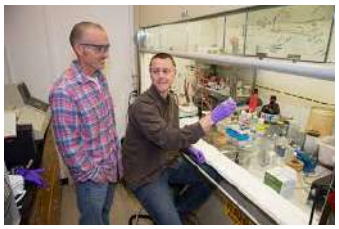
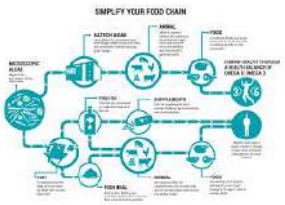
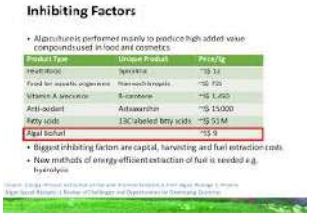
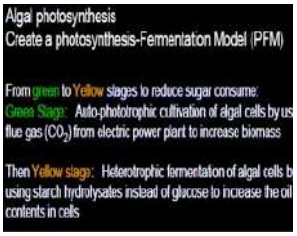



OMEGA System

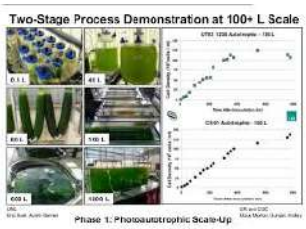


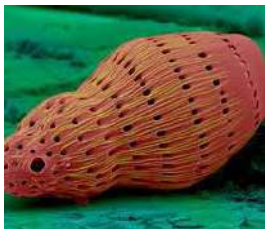


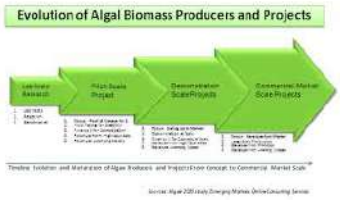

Uniqueness of algae fuels

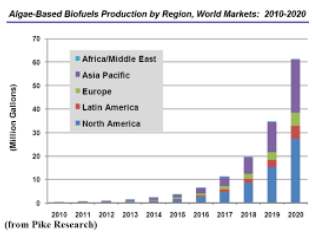
ASU


SIMPLIFY YOUR FOOD CHAIN

Inhibiting Factors

Algal photosynthesis
Create a photosynthesis-Fermentaton Model (PFM)
From green to Yellow stages to reduce sugar consume:
Green Stage: Auto-phototrophic cultivation of algal cells by us
flue gas (CO_2) from electric power plant to increase biomass
Then Yellow stage: Heterotrophic fermentaton of algal cells b
using starch hydrolysates instead of glucose to increase the oil
contents in cells

HUAKANG BIOTECHNOLOGY
Professional Plant Extract Manufacturer


Two-Stage Process Demonstration at 100+ L Scale
Phase 1: Photoautotrophic Scale-Up

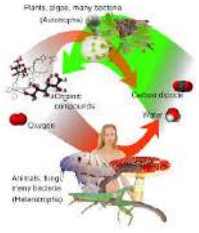



Why Microalgae?
Slow growth of higher plants
High fresh water requirement of higher plants
High cost of land for growing higher plants
No competition with food supply

Evolution of Algal Biomass Producers and Projects

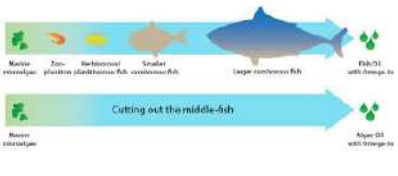
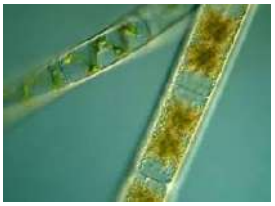

Algae-Based Biofuels Production by Region, World Markets: 2010-2020
(Million Gallons)
Africa/Middle East
Asia Pacific
Europe
Latin America
North America
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
(from Pike Research)




Algae oil extracted under pressure
Sunlight
Algae
Biofuel refinery
Existing vehicles
Biofuel sales

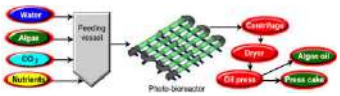


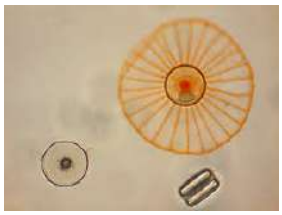

Manufer
AQUACULTURE NUTRIENTS


Cutting out the middle-fish




Where do Algae live?

Food & Fuel
for the 21st Century

Water
Algae
CO2
Nutrients
Feeding vessel
Photo-bioreactor
Centrifuge
Dryer
Oil press
Algae oil
Press cake



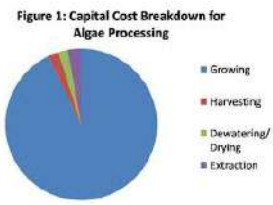
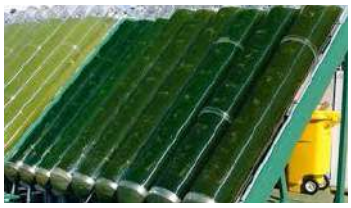


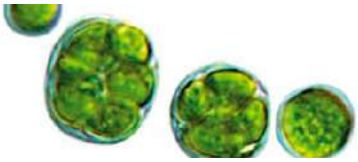
Figure 1: Capital Cost Breakdown for Algae Processing
Growing
Harvesting
Dewatering/ Drying
Extraction

Alga: Latin "Seaweed"
Aquatic organisms that contain chlorophyll and other pigments and can carry on photosynthesis

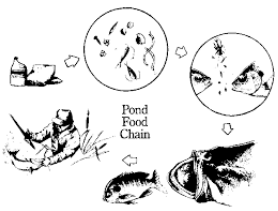


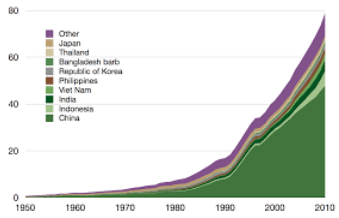
Modular ingredient design.
Each ingredient plays a specific role in whole-body nutrition



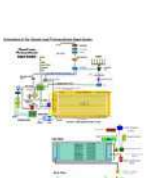
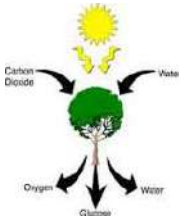
Overview: FDA Biotechnology Regulations
• Engineered algae used for food, food additive, pharmaceutical production would be subject to FDA product specific regulations.
• These regulations focus more on safety, efficacy of end product, and less on risks of production organism.
• Algae used for an FDA-regulated purpose would likely be exempt from EPA oversight under TSCA.

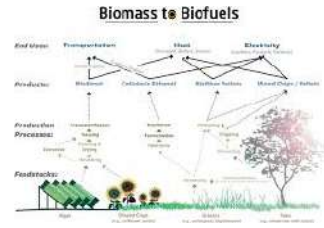

Pond
Food
Chain



80
60
40
20
0
1950
1960
1970
1980
1990
2000
2010
Other
Japan
Thailand
Bangladesh barb
Republic of Korea
Philippines
Viet Nam
India
Indonesia
China


Background
• Location
– Most habitats
• How many
– Over 36,000 species
• How does it feed?
– Photosynthesis
– All have chlorophyll
• Uses
– food, fertilizer, feedstock, pharmaceutical, pollution control, water treatment, dyes, agar, Fuels

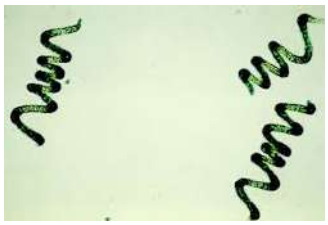
Algae (bioplastic)
Algae (food)

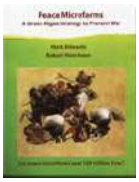



Carbon Dioxide
Waste
Oxygen
Water
Glucose

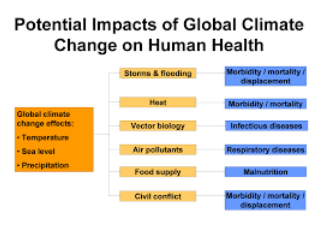


Biomass to Biofuels



ReNew Algae
ReNew Fuel
ReNew Feed
ReNew Omega-3





FeaceMicrofarms

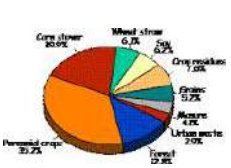

Potential Impacts of Global Climate Change on Human Health
Global climate change effects:
- Temperature
- Sea level
- Precipitation
Storms & flooding
Heat
Vector biology
Air pollutants
Food supply
Civil conflict
Morbidity / mortality displacement
Morbidity / mortality
Infectious diseases
Respiratory diseases
Malnutrition
Morbidity / mortality / displacement


Algae Alliance.com

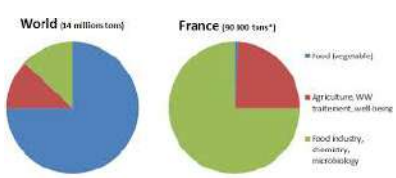


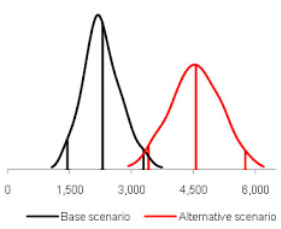

Biodiesel Feedstock Options by Region - Brazil

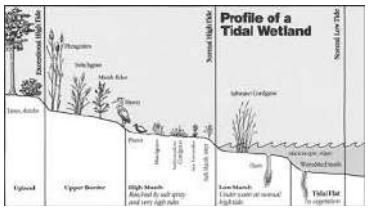


FreedomFoods

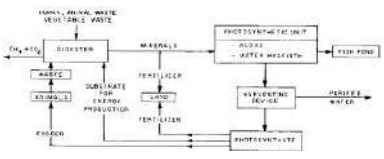

World (34 millions tons)
France (90 000 tons*)
Food (vegetable)
Agriculture, WW traitement, well-being
Food industry, chemistry, microbiology
the use of seaweed in the world and in France (*withimports).
Data from the CEVA.

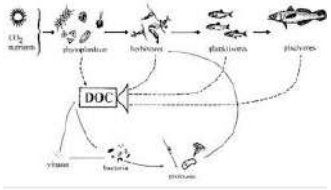

0
1,500
3,000
4,500
6,000
Base scenario
Alternative scenario

Beneficial bioproducts from algae
Algae pond
Food
Animal Feed
Fertilizer/nutrients

Profile of a Tidal Wetland



Biofuels

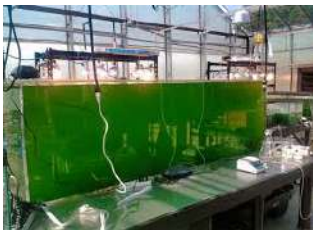

Microfarms: Raceways, PhotoBioreactors, Bags, Plates and Tubes



DOC

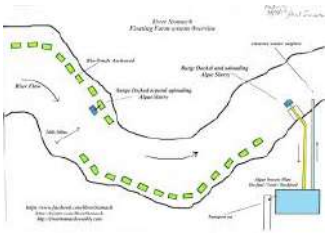

oilgae
Comprehensive Report on Attractive Algae Product Opportunities
Download Free Preview of the Report

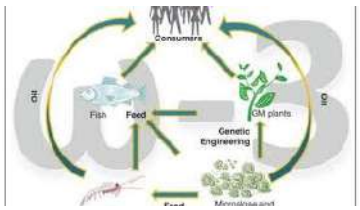

Fish, Flax & Borage Oil
HEART HEALTH

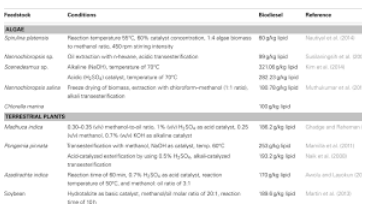

InteSusAl
Integrated Sustainable Algae

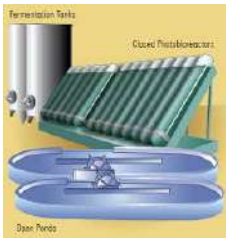


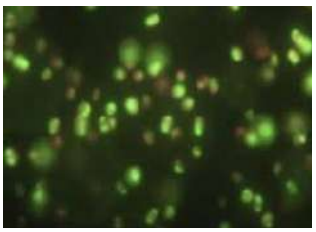

BREAKTHROUGH BIOTECHNOLOGY PLATFORM




Consumers
Fish
Feed
GM plants
Genetic Engineering

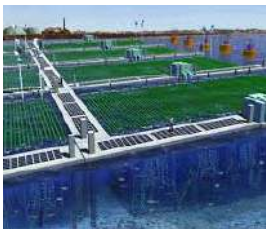



Fermentation Tanks
Closed Photobioreactor
Open Ponds







Nutrition Facts


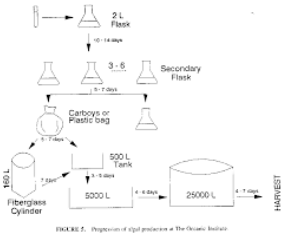
Soylent

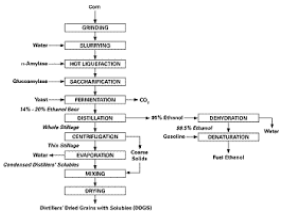


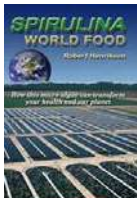
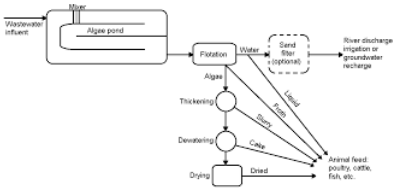
OriginOil

SPIRULAST

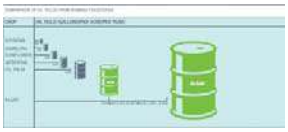



2 L Flask
Secondary Flask
Carboys or Plastic bag
500 L Tank
5000 L
25000 L
Fiberglass Cylinder
HARVEST



GRINDING
SLURRYING
HOT LIQUEFACTION
SACCHARIFICATION
FERMENTATION
DISTILLATION
CENTRIFUGATION
EVAPORATION
MIXING
DRYING
DEHYDRATION
DENATURATION



SPIRULINA
WORLD FOOD

Mixer
Wastewater influent
Algae pond
Flotation
Water
Send filter (optional)
River discharge irrigation or groundwater recharge
Algae
Thickening
Liquid
Foam
Slurry
Cake
Dewatering
Animal feed: poultry, cattle, fish, etc.
Drying
Dried


Ethanol
Biodiesel

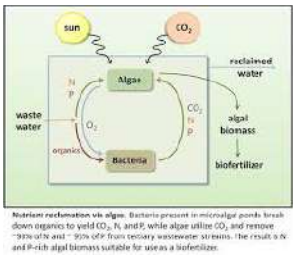
Algae Industry Magazine.com
SCALABLE ALGAE MICROFARMS


Protecting the soil and growing crops with sustainable agriculture

HORIZON
ORGANIC
DHA Omega-3

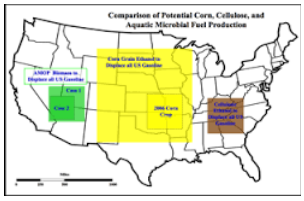
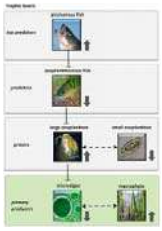
Open Pond

300×300


sun
CO_2
reclaimed water
Algae
waste water
algal biomass
organics
Bacteria
biofertilizer

Spirulina


400
200
100
50

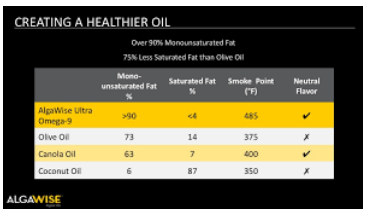

Comparison of Potential Corn, Cellulose, and Aquatic Microbial Fuel Production




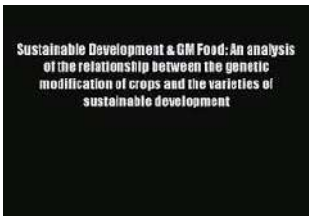
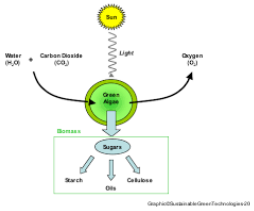


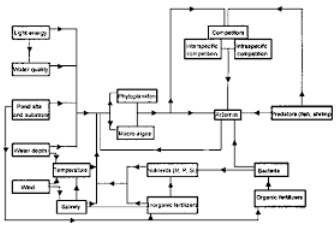
AlgiSys

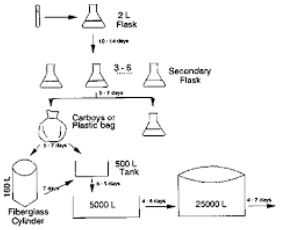
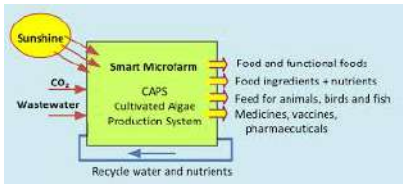
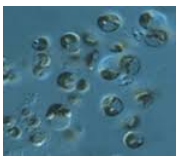


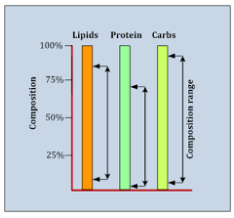


CREATING A HEALTHIER OIL
Over 90% Monounsaturated Fat
75% Less Saturated Fat than Olive Oil
Mono-unsaturated Fat %
Saturated Fat %
Smoke Point (°F)
Neutral Flavor
AlgaWise Ultra Omega-9 >90 <4 485 ✔
Olive Oil 73 14 375 ✗
Canola Oil 63 7 400 ✔
Coconut Oil 6 87 350 ✗
ALGAWISE




Sustainable Development & GM Food: An analysis of the relationship between the genetic modification of crops and the varieties of sustainable development

Sun
Light
Water (H2O)
Carbon Dioxide (CO2)
Oxygen (O2)
Green Algae
Biomass
Sugars
Starch
Oils
Cellulose

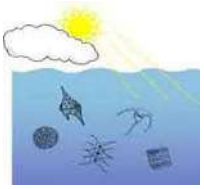

Competitors
Interspecific competitors
Intraspecific competition
Light energy
Water quality
Pond site and substrate
Phytoplankton
Predators (fish, shrimp)
Water depth
Temperature
Wind
Salinity
Bacteria
Organic fertilizers


2 L Flask
10 - 14 days
3 - 5
Secondery Flask
5 - 7 days
Carboys or Plastic bag
3 - 7 days
500 L Tank
5 - 5 days
160 L
Fiberglass Cylinder
7 days
5000 L
4 - 6 days
25000 L
4 - 7 days

Sunshine
CO2
Wastewater
Smart Microfarm
CAPS
Cultivated Algae
Production System
Food and functional foods
Food ingredients + nutrients
Feed for animals, birds and fish
Medicines, vaccines, pharmaceuticals
Recycle water and nutrients


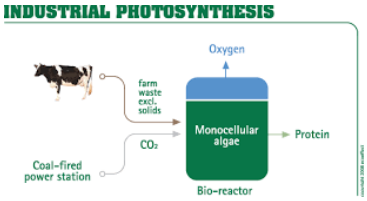
Advances in
Biofuel Production
Algae and Aquatic Plants

Lipids
Protein
Carbs
100%
75%
50%
25%
Composition
Composition range

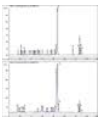


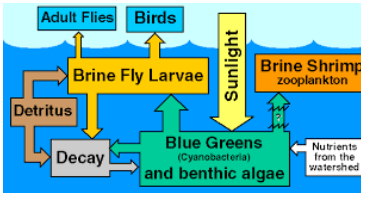


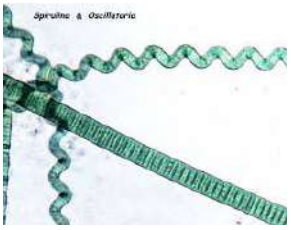


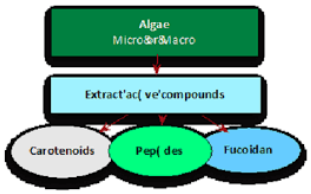
SMART
MICROFARMS











Algae-based Medical Compounds

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