potential of using algae in cosmetics

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Introduction

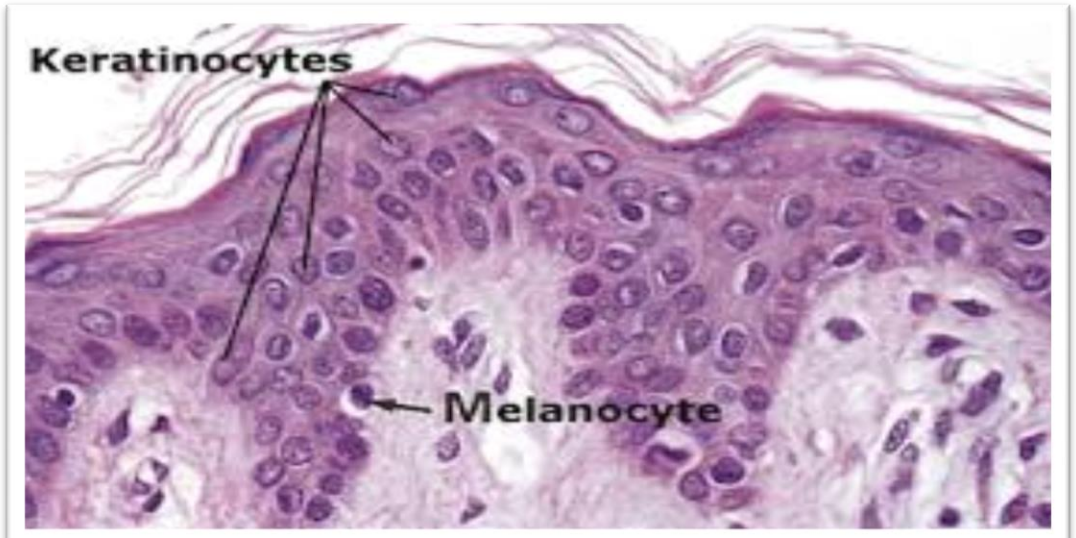
Skin:

the skin has an important role in many physical functions. Skin is composed of the **epidermis**, **dermis** and **hypodermis**.

- In the **epidermis**:

keratinocyte cells → repair skin damage

melanocytes → contain **melanin**, thus determining skin color and protecting the skin from UV light.



Introduction

Skin:

- **Collagen** and **elastin**, → provide support for the skin.
- **Hyaluronic acid (HA)** is also a major component of the dermis, where it is involved in tissue repair.

HA is of fundamental importance in water retention, and can absorb water about **1000 times** its own volume.

collagen and HA break down with aging, **causing wrinkles to appear and the skin to lose firmness.**

Introduction

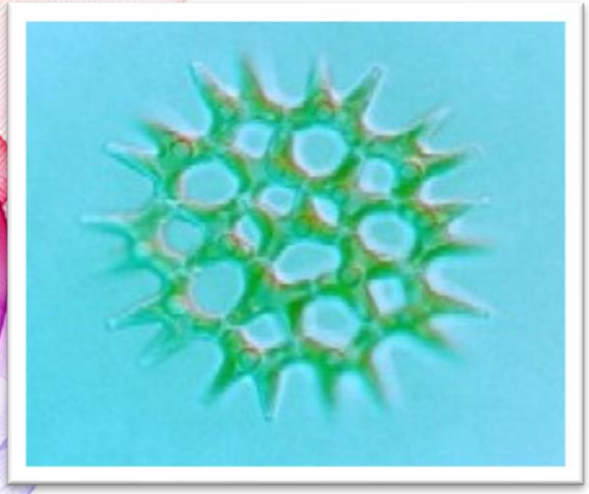
the definition of the Federal Food, Drug & Cosmetic :

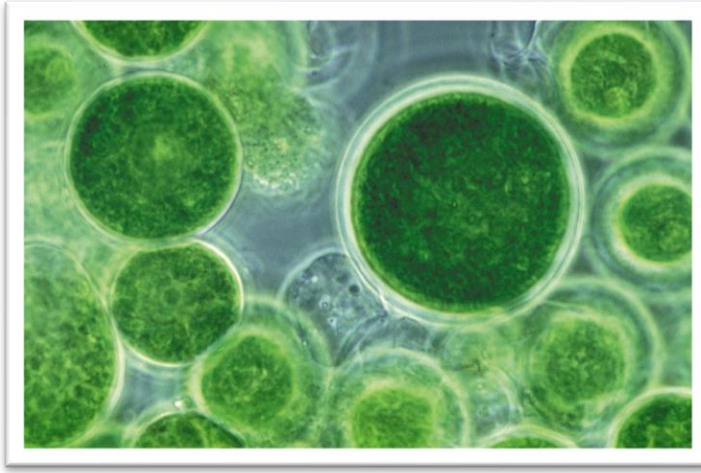
a **cosmetic** product is any substance or preparation that is to be rubbed, poured, sprinkled, or sprayed on, introduced into or applied to external parts of the body , in particular the epidermis, hair and capillary systems, nails, lips and external genitals, or to the teeth and the mucous membranes of the oral cavity as the product cleans, perfumes, protects them, modifies their appearance, keeps them in good condition or helps to reduce body odors.

Microalgae:

are **unicellular** or **simple multicellular** species that grow **rapidly**, living in **harsh conditions** and with standing environmental stressors such as **heat**, **cold**, **anaerobiosis**, **salinity**, **photooxidation** ,**osmotic pressure** and exposure to **ultra-violet radiation** .

✓ **Microalgae** are superior to conventional plants in Terms of productivity, limited seasonal variation, easier extraction and abundant raw materials .





Macroalgae (seaweeds):

Macroalgae can be divided into three groups based on their **dominant pigments**:

- Chlorophyceae (green algae).
- Phaeophyceae (brown algae).
- Rhodophyceae (red algae).

Macroalgae can be cultivated on seashores on a large scal Their growth rate is **relatively rapid**, and it is possible to control the production of their bioactive compounds such as proteins, polyphenols and pigments by manipulating the culture conditions.

application of algae :

The application of algae based on their valuable bioactive chemical constituents has gained considerable attention in recent years , with applications in areas such as:

1. food.
2. Medicine.
3. cosmetics.
4. aquaculture and horticulture.
5. In addition, **diatoms** are also applied in nanotechnology,
6. optical systems.

Use of algae in cosmetics

Use of algae in cosmetics:

Introduction:

There are many **polysaccharides** that can be used in cosmetics with different morphologies and functions.

Marine algae are the most abundant source of natural polysaccharides, such as:

Alge group	polysaccharide
brown algae	fucoidans
red algae	carrageenans
green algae	ulvans

❑ **Polysaccharides** have a large number of cosmetic functions . For example, they act as suspending agents, hair conditioners, and wound-healing agents, and can also moisturize, hydrate, emulsify, and emolliate .

1- Algae against skin aging

Skin aging:

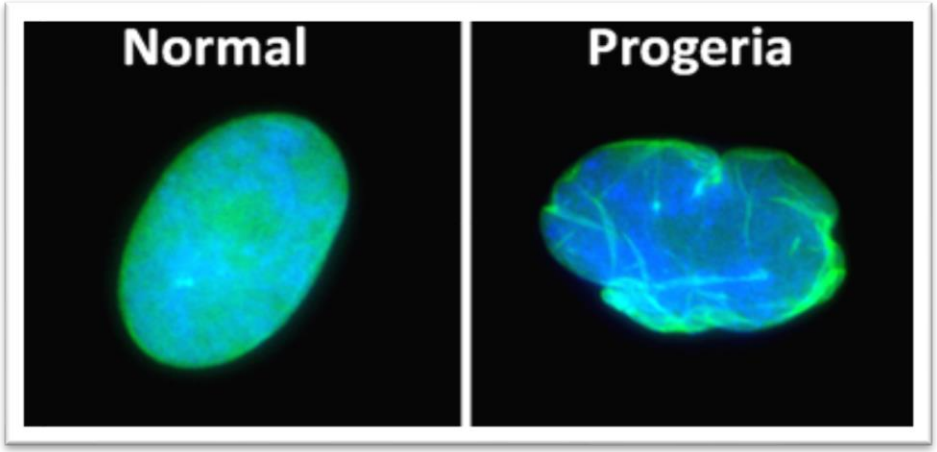
is a slow, complex process of intrinsic and extrinsic aging. Aging of skin causes many changes, including thinning, dryness, laxity, fragility, enlarged pores, fine lines and wrinkles.

1- Algae against skin aging

Progerin:

a truncated version of the amin . A protein, works with telomeres to trigger cellular senescence in normal human fibroblasts .

An extract from an **edible seaweed**, called *Alaria esculenta*, has been shown to induce a significant ↓ **decline** in the amount of progerin in aged fibroblasts.

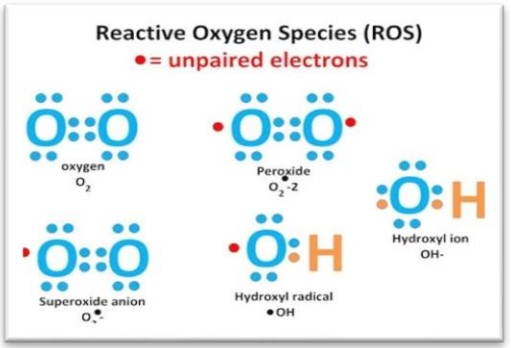


1- Algae against skin aging

Photo-protectivity and antioxidant capacity of algal extracts and compounds

ROS can induce cell death via **apoptotic** or **necrotic processes**, and this is clearly noticeable with the presence of wrinkles and skin dryness.

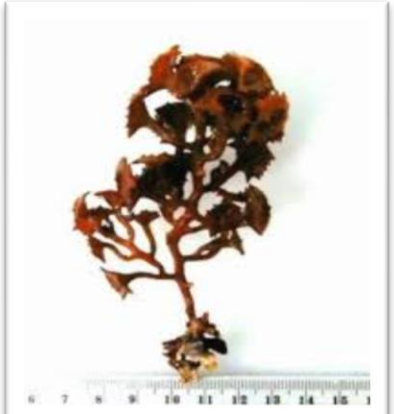
Skin naturally possesses antioxi dant agents



block reactive oxygen species (ROS)

1- Algae against skin aging

brown algae	red algae
laminaran, fucoidan alginate	**mycosporine-like amino acids (MMAs)**
• *Fucus vesiculosus* • *Turbinaria conoides*	*Porphyra umbilicalis*
have antioxidative properties	Can absorb UV light ,and thus act as sunscreen



2- Skin whitening

Skin whitening is a common practice all over the world, particularly in **Asia** .

This is because white skin is seen as beautiful in Asian culture, and thus skin whitening products account for a large share of the cosmeceutical market in this region.

2- Skin whitening

Tyrosinase:

Marine algae have recently attracted attention in the se arch for natural tyrosinase inhibitor agents

(Tyrosinase is an oxidase that is the rate-limiting enzyme for controlling the production of melanin.).

Fucoxanthin isolated from *Laminaria japonica* has been reported to suppress tyrosinase activity.

3- Application of algae as moisturizing agent

Moisturization:

"**moisturization is the first step in acting against aging of the skin "**

Furthermore, the level of skin moisturization is strongly linked to its defense of irritant agents or frequent washing with strong tensioactive materials.

3- Application of algae as moisturizing agent

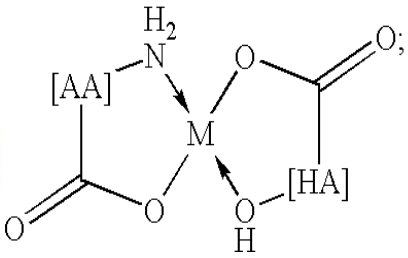
hydroxy acid (HA) vs algae polysaccharides

- Cosmetic formulations containing **hydroxy acid (HA)** have been used in clinical practice to moisturize the skin.
- HA can be found in **plants** and **animals**, but since the supply of HA is limited, the price is relatively high.
- In contrast, polysaccharides derived from algae are **abundant** and **environmental-friendly** raw materials, which are relatively **cheap.**

3- Application of algae as moisturizing agent

hydroxy acid (HA) vs algae polysaccharides

polysaccharides extracted from *Saccharina japonica* (brown algae)



hydroxy acid (HA)

4- Use of algae as a thickening agent

(to control viscosity to produce an appealing liquidity in cosmetic products.)

A- Alginic acids:

which are **polysaccharides** isolated from **brown algae** and **bacteria**.

are good **hydrocolloids** that can be used to **thicken** and **stabilize** emulsions.

Thus they can be applied in many cosmetic products, **Alginic acids absorb water quickly** and provide cellular support to keep the cells of brown algae and bacteria from collapsing, and this is the basis of their use in cosmetic formulations.

4- Use of algae as a thickening agent

B- Agar :

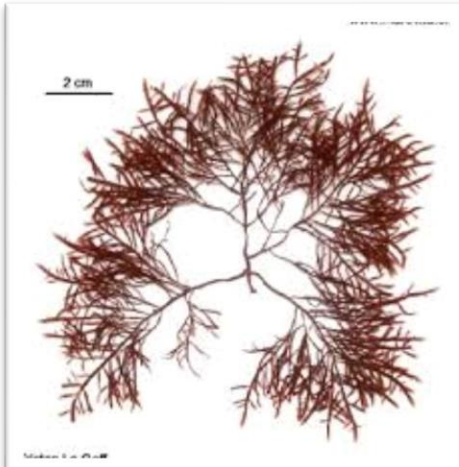
is a **polysaccharide** that can be applied as a **thickener** to control both **viscosity** and **emollience** in cosmetic products,

✓high quality

✓more than %50of agar is now produced from red al gae

Agar is extracted from red algae, such as:

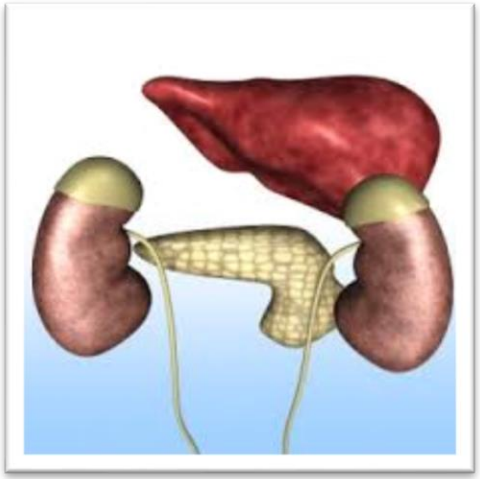
- *Pterocladia,*
- *Pterocladiella*
- *Gelidium*



5- Application of algae as pigmenting agent: carotenoids

Introduciton:

- There is now increasing demand for natural pigments derived from **carotenoids**, rather than those that are **chemically synthesized**.
- as the latter are suspected of being carcinogenic, inflecting damage on the liver and kidneys.



5- Application of algae as pigmenting agent: carotenoids

Introduciton:

The price of natural pigments isolated from algae can be as much as **700 Euros per kilo**, more than double that of synthetic products .

The Chlorophyceae family, including

- *Dunaliella,*
- *Muriellopsis,*
- *Chlorella* and
- *Haematococcus*,

is the most common source of **Carotenoids**

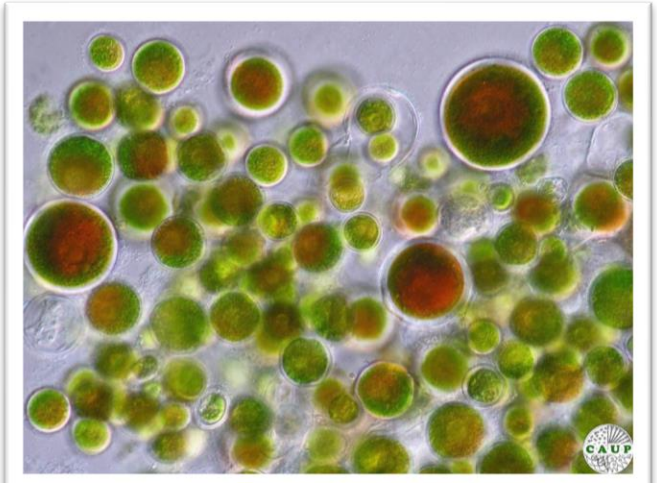
Astaxanthin :

is the main carotenoid found in *Haematococcus Pluvialis* .

✓It is an **excellent antioxidant**, more powerful than **vitamins C and E or other carotenoids**.

It has been reported that astaxanthin can:

1. suppress skin hyper-pigmentation
2. inhibit synthesis of melanin
3. improve the condition of all skin layers via both topical and oral use



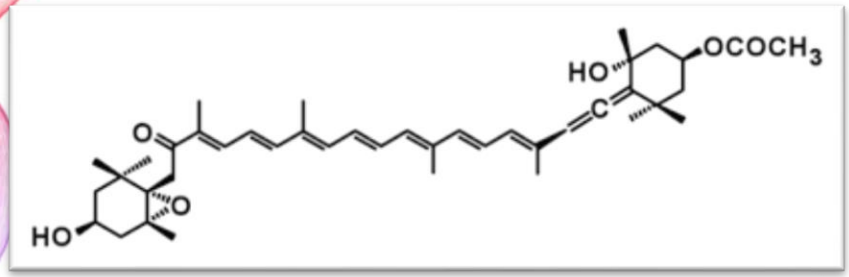
Fucoxanthin:

is the main carotenoid present in the chloroplasts of brown algae, such as

Cercis siliquastrum, Undaria pinnatifida, Sargassum fulvellum, L. japonica and *H. fusiformis*.

It is estimated that **fucoxanthin** accounts for more than 10% of the total production of natural carotenoids.

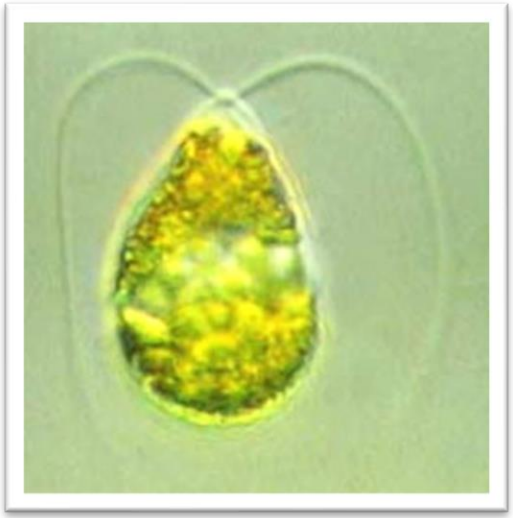
- suggested that fucoxanthin enhanced the **fat burning** rate of fat cells in the adipose tissue due to an increase in thermogenin.



b-carotene:

Microalgal **b-carotene**, known to be a vitamin precursor, is one of the leading **food colorants**, produced mainly from *Dunaliella spp.* or from *Spirulina platensis*.

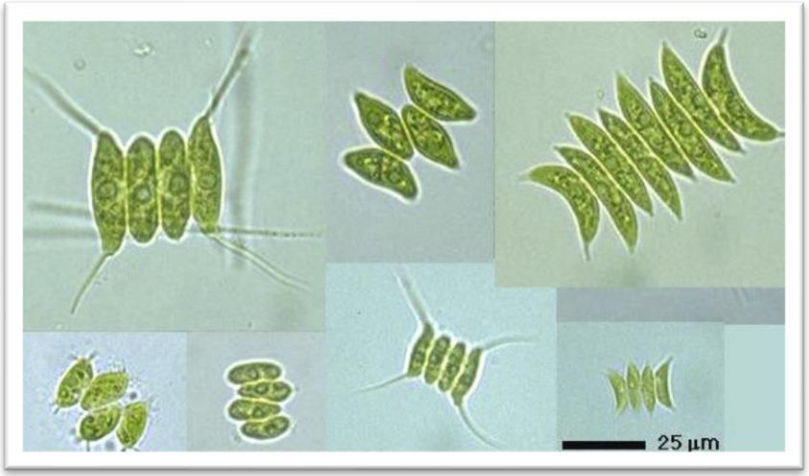
b-Carotene also has a strong antioxidant capacity, which helps to **counteract the free radicals** involved in gastrointestinal cancer ,arthritis or premature aging.

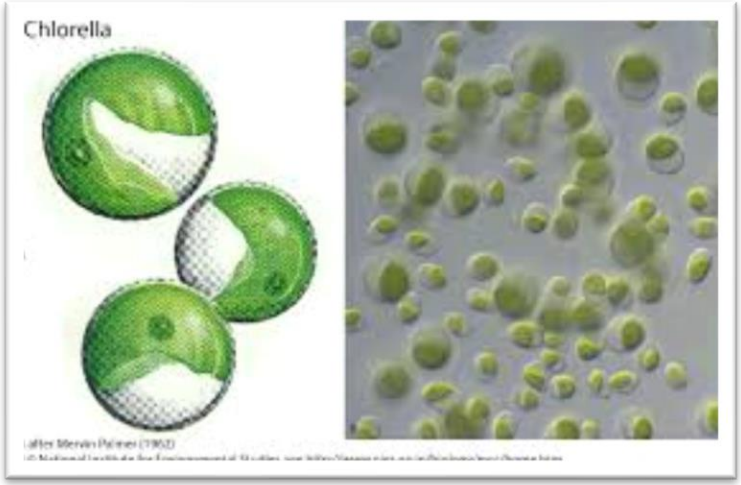


5- Application of algae as pigmenting agent: carotenoids

Lutein:

Lutein is an intracellular algal product found in *Scenedesmus and Chlorella* , and has been found in the epidermal and dermal layers, protecting the skin from UV-induced damage,
luteins are often applied in food coloring, drug and cosmetics.





5- Application of algae as pigmenting agent: carotenoids

Lutein:

Reports indicate that lutein plays an active role in preventing:

- acute and chronic coronary symptoms.
- maintaining normal visual functions.
- hindering the development of cataracts.
- stimulating the immune response.
- delaying progression of early atherosclerosis.
- avoiding gastric infection.
- inhibiting macular degeneration linked to age .

5- Application of algae as pigmenting agent: carotenoids

Lutein:

Despite the many benefits of lutein, as yet there is a lack of mass production on a commercial scale, although efforts are now underway to establish the outdoor production of **microalgae-based lutein**

Study (2015)

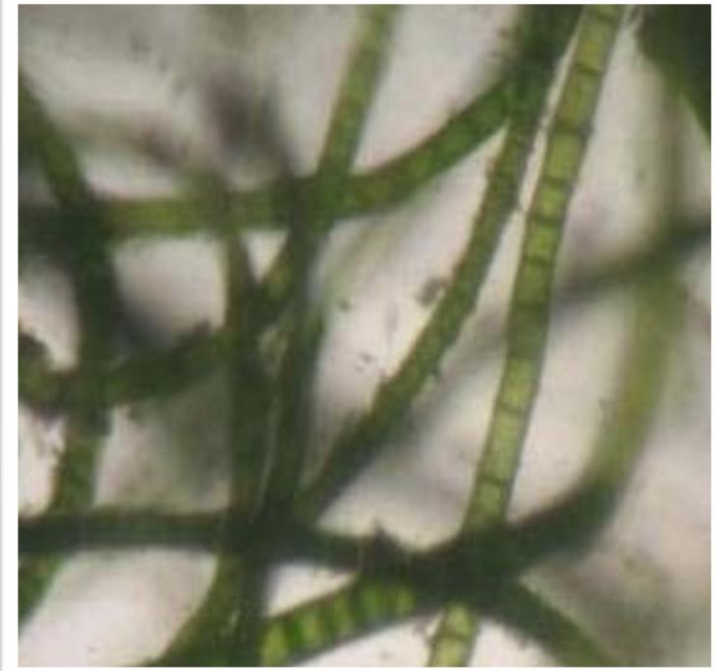
Chemical Composition of Extracts From Chaetomorpha linum (Miller) Kütz.

A Potential Use in the Cosmetic Industry

Introduction

Mediterranean Sea is recognized to be a global bio diversity hotspot.

The Chaetomorpha genus belongs to the Chlorophyta division. Chaetomorpha means stiff hairs.

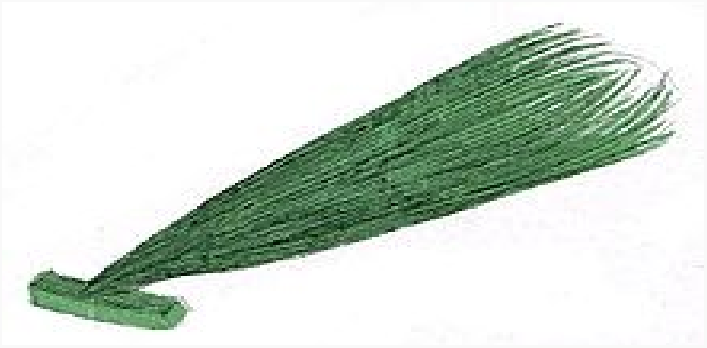


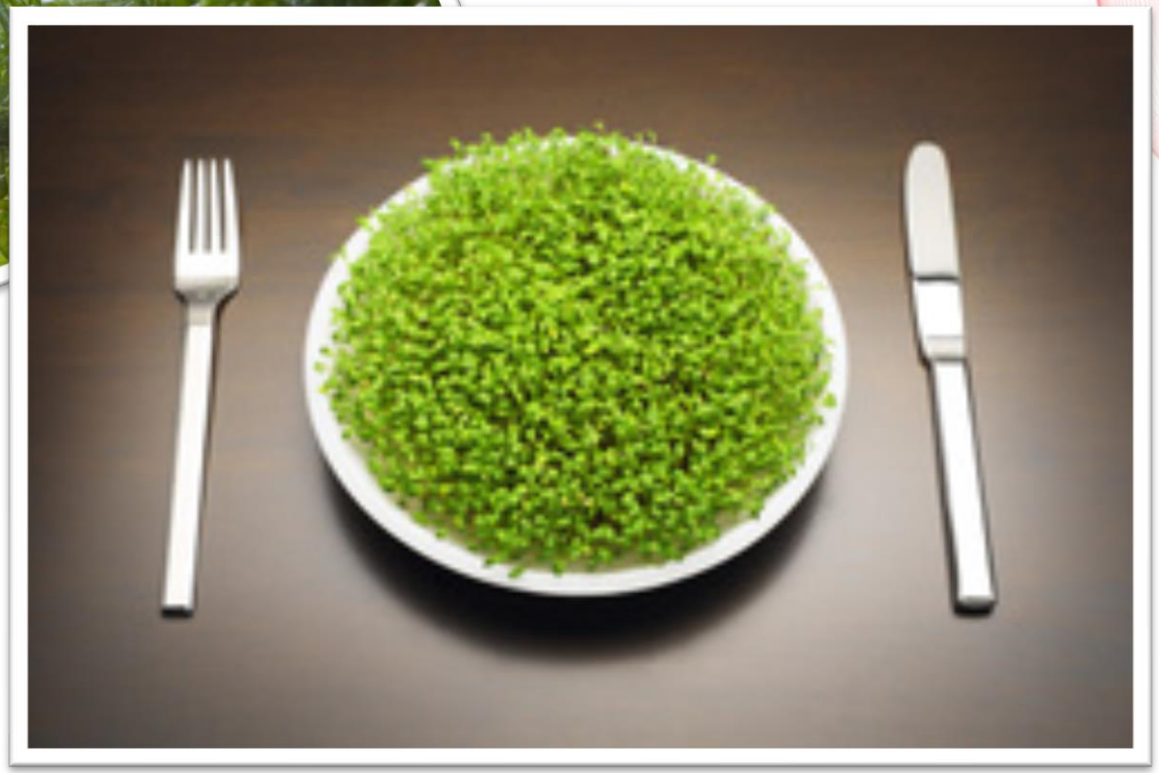
Introduction

Chaetomorpha linum:

(spaghetti algae)

- a delicate green seaweed. , it grows as a **filamentous** loosely entangled mass.
- Usually free-floating, it may also be **attached to rocks and shells**.
- unbranched and usually between **5 and 30 cm** in length

Chaetomorpha linum	
	
Chaetomorpha linum	
Scientific classification	
Kingdom:	Plantae
Division:	Chlorophyta
Class:	Ulvophyceae
Order:	Cladophorales
Family:	Cladophoraceae
Genus:	Chaetomorpha
Species:	***C. linum***
Binomial name	
Chaetomorpha linum (Muller) Kütz., 1849	



spaghetti algae

Chaetomorpha linum:

(spaghetti algae)

- is popular in reef aquariums for its ability to:

1. remove nitrates.
2. assist in buffering pH.
3. uptake carbon dioxide producing oxygen

Materials and Methods

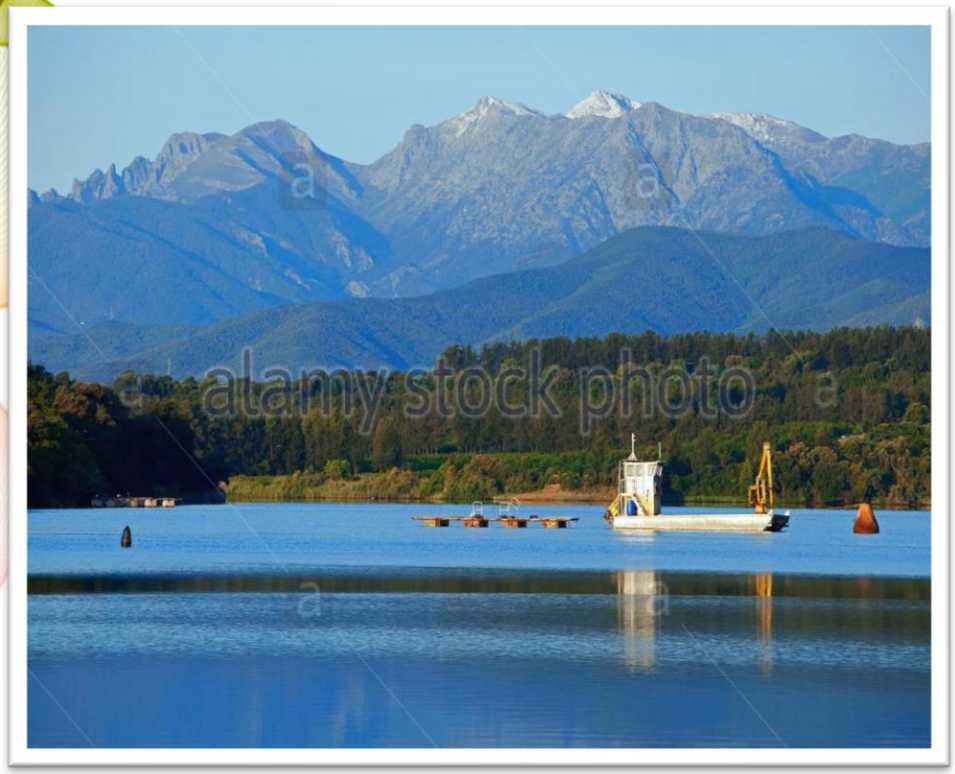
Material and Isolation:

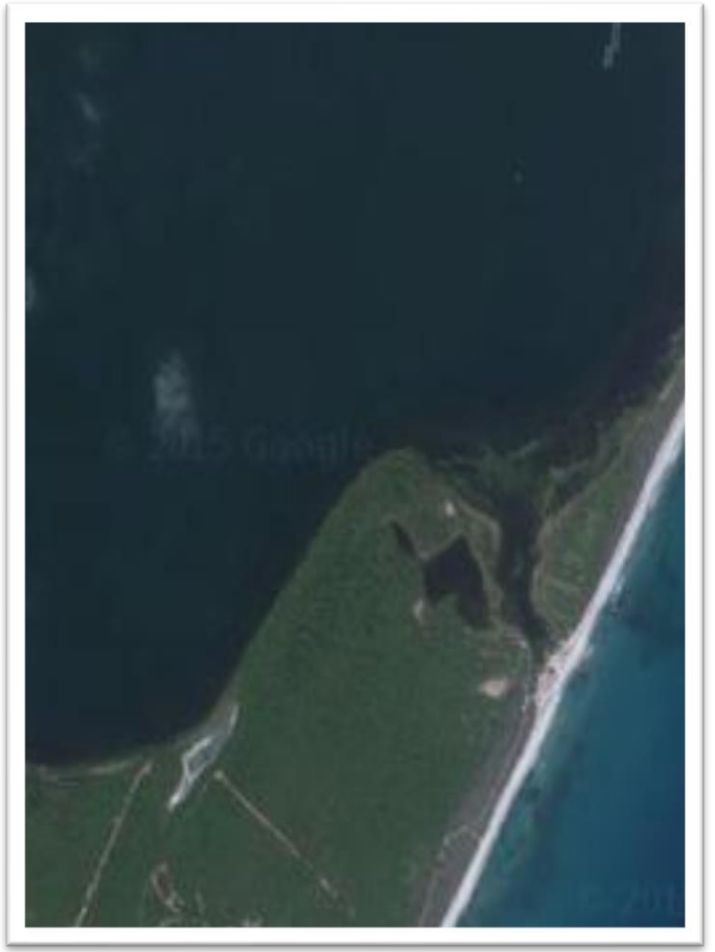
1- Chaetomorpha linum (Miller) Kütz. was collected at **20 cm deep** in **Urbino pond** in the East coast of Corsica (France). on September 2013

2- Alga were **dried** and then extracted with solvent extracts of increasing polarities (**pentane and ethyl acetate**) using a **Soxhlet apparatus** during 4 hours.

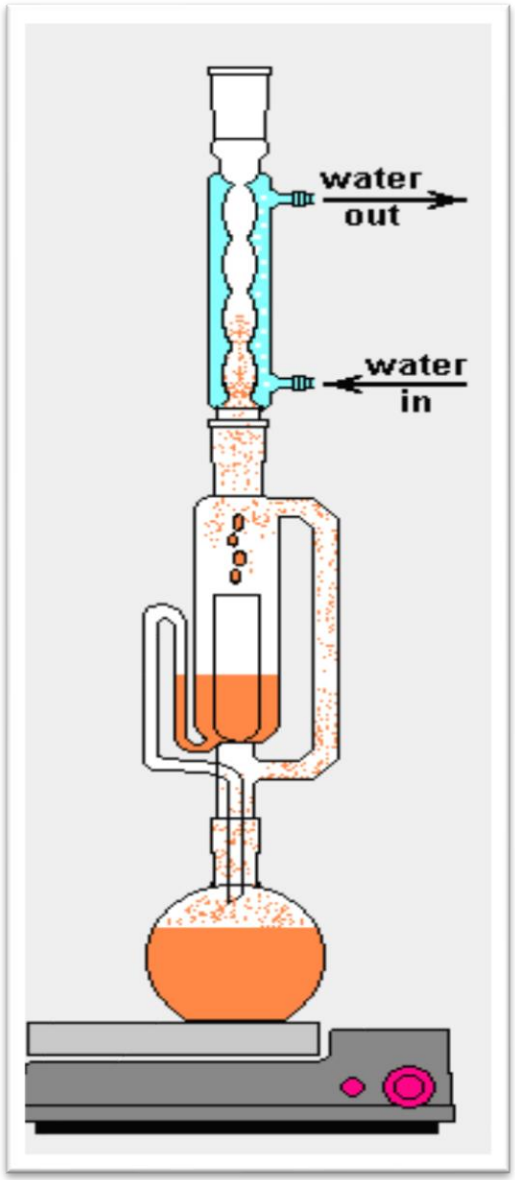
3- Solvent was **evaporated** under reduced pressure to yield a **dark yellow** (pentane extract) and **dark green** (ethyl acetat).

4- Each extract were **chromatographed** using **a Grace Reveleris® flash chromatography system.**

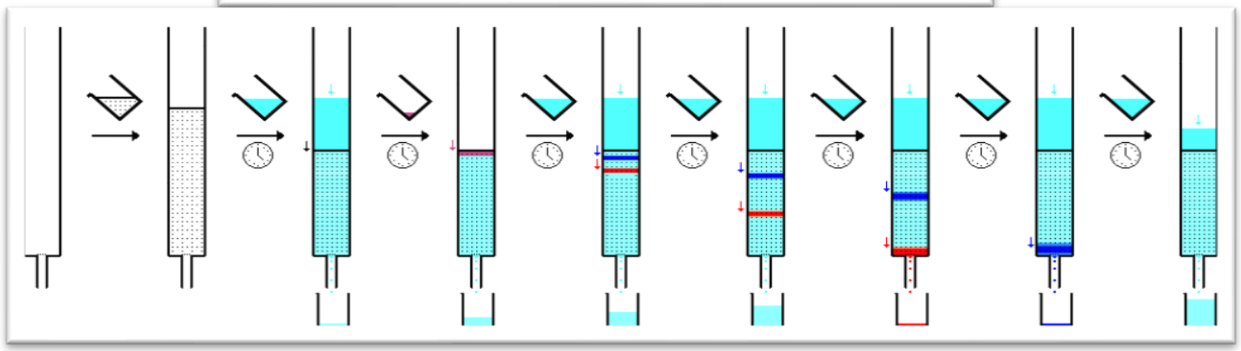




france, east coast, Costa Serena, Urbino pond



Soxhlet apparatus



Grace Reveleris® flash chromatography system.

Materials and Methods

2- Saponification.

3- GC-MS

4- Quantification of Fatty Acids Methyl Esters

5- 13C NMR

6- Cytotoxic Assay:

Dried and powdered Chaetomorpha linum mixture of deionised water and propan.

Cytotoxic assay were performed by the society "Laboratoire Shadeline" using an **in vitro test on human keratinocytes.**

Results and Discussion

Eighteen compounds (Table 1) have been identified in total from the 2 extracts (pentane and ethyl acetate):

Table 1: Compounds indentified from both Pentane (PE) and Ethyl Acetate Extracts (EAE)

No.	Compounds	PE	EAE	Identification
	Fatty Acid Methyl Esters			
1	Myristic acid ME (C14:0)	×		MS, Rt
2	Palmitic acid ME(C16:0)	×	×	MS, Rt
3	Palmitoleic acid ME (C16:1)	×		MS, Rt
4	Stearic acid ME (C18:0)	×	×	MS, Rt
5	Oleic acid ME (C18:1)	×		MS, Rt
6	Linolelaidic acid ME (C18:2)	×		MS, Rt
	Sterols			
7	Cholesterol	×	×	^{13}C NMR, MS, Rt
8	β-Sitosterol	×	×	^{13}C NMR, MS, Rt
9	24-Methylene-cholesterol		×	^{13}C NMR
10	(*E*,*E*)-Cholesta-5,22-dien-3-ol		×	^{13}C NMR
	Terpenes			
11	Phytol and phytyls derivatives	×		^{13}C NMR
12	Abietic acid	×	×	^{13}C NMR
13	Dehydroabietic acid	×	×	^{13}C NMR
14	Methyl dehydroabietate	×	×	^{13}C NMR
	Phenols derivatives			
15	*p*-Hydroxybenzaldehyde		×	^{13}C NMR, MS
16	*p*-Hydroxybenzoic acid		×	^{13}C NMR, MS
	Others			
17	(*E*)-2-tridecyl-2-heptadecenal	×		^{13}C NMR
18	Thymine			^{13}C NMR, MS

Results and Discussion

Cytotoxic assay :

Even at the higher concentration tested (1000 µg/m L), the extract exhibits **no cytotoxicity** against human keratinocytes .

Conclusions

Red, brown and green algae have different fatty acid and sterol profiles, which have a chemotaxonomic significance for seaweeds.

C. linum extract shows no cytotoxicity against human k eratinocytes. The wide biological activity described of compounds have a potential use of *C. linum* extract in the **cosmetic industry**.

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Thank you ..