

**Nannochloropsis oculata**, a single celled green alga.

*Nannochloropsis oculata* belongs to the class Eustigmatophyceae. This class consists of about six genera that were separated from the Xanthophyceae (Yellow-green algae); it seems likely that more general will be transferred into the class from the Xanthophyceae in the future. Used in the production of aquarium feeds, lipids for biofuels and nutraceuticals (derived from food),

The eustigmatophyceae are small microalgae that are planktonic or grow attached to various substrates. They are unique in lacking chlorophyll pigments other than **Chlorella** a (Fisher et al. 1998).

*Nannochloropsis oculata* is one of the five identified species of the genus. These species are characterized by small cells with simple morphology and typically live in salt-water habitats. *Nannochloropsis* species are widely used as food in aquaculture and have been proposed as a commercial source for the dietary supplement an omega-3 fatty acid (Sukenik et al. 1989).

Nannochloropsis is a very useful genus of algae. It grows fast and produces large quantities of biomass. The cells of this species are small 2 microns (um), non-motile (not capable of movement), green in colour. It is different from other related microalgae in that it lacks chlorophyll-n and c. Nannochloropsis is able to build up a high concentration of a range of pigments such as astaxanthin (a potent antioxidant) and canthaxanthin (an orange-yellow pigment).

**Isochrysis galbana**, a single celled golden alga.

Nearly every aquaculture facility that farms filter feeders will culture Isochrysis as a food supply for their farmed organisms. Isochrysis galbana, like other members of this class, is rich in polyunsaturated fatty acids including DHA, which are of nutritional value for marine fish larvae and juvenile stages of molluscs. This organism grows well in captivity and is a “model organism” commonly used by researchers who study marine systems and photosynthesis.

The thallus, or body of the organism, appears as a single cell with flagella. This strain also has a high concentration of the pigment fucoxanthin which is an accessory pigment for photosynthesis, and some have claimed that it has nutraceuticals benefits for humans and animals for weight loss.

Growing Isochrysis requires seawater. As they are flagellated, they can grow without mixing being a requirement, however mixing does greatly help to increase growth the rates

**Chlorella vulgaris**, a single celled green alga.

One of the most studied genera of algae, Chlorella has been used to understand energy metabolism. This freshwater alga was employed in the 1940-1950s by Otto Warburg in Germany to build an understanding of respiration and photosynthesis. His work was expanded upon by Melvin Calvin, James Bassham, and Andrew Benson, using radioactively labelled carbon (C<sup>14</sup>) at the University of California, Berkley. Their work led to the understanding of carbon fixation (turning non-biological carbon into new organic molecules).

Many people believe Chlorella could serve as a potential source of food and energy because its photosynthetic efficiency is very high, compared to other crops such as sugar cane.

Chlorella is a freshwater genus of single-cell green algae belonging to the phylum Chlorophyta. It is spherical in shape, about 2 to 10µm in diameter, and does not have flagella. Chlorella contains the green photosynthetic pigments chlorophyll-a and -b in its chloroplast. Through photosynthesis, it multiplies rapidly, requiring only carbon dioxide, water, sunlight, and a small number of minerals to reproduce.

### **Spirulina, Arthrospira platensis, Colonial cyanobacteria**

Spirulina is the common name of the colonial blue-green algae *Arthrospira platensis*. *Arthrospira* occurs naturally worldwide and is cultivated on every continent except for Antarctica. It is farmed in large outdoor ponds, dried and sold into the dietary supplement, animal feed, and pigment markets. As a supplement, claims have been made regarding spirulina's anti-inflammatory properties, believed to arise from the pharmacology of the pigment phycocyanin.

Spirulina contains more protein by mass than steak. As an animal feed, it supplies vitamins and can add pigmentation to fish. The pigment phycocyanin is useful for research and in the medical industry as it has unique fluorescent properties.

When starting an *Arthrospira* culture, it is important to keep the light level low for the first weeks, as the culture is getting used to its new habitat. Also, the water must be chlorine-free, using bottled drinking water is best. For larger cultures, using a carbon filter to treat municipal water will often work just fine. Healthy *Arthrospira* is positively buoyant and will float to the top of the water mix it back into the water column with air bubbles to maximise growth rates.

### **Dunaliella salina – Orange/ Red**

*Dunaliella salina* also contains superoxide dismutase (SOD), **lutein, cryptoxanthin** and **zeaxanthin** which are **antioxidants** that can boost **skin hydration** and promote normal healthy skin. *Dunaliella* is a unique unicellular species of algae containing rich *concentrations* of carotenoids (mainly *Beta-Carotene*), *antioxidants* and essential *vitamins*. Among various carotenoid-rich microalgae, *D. salina* has the greatest carotene concentration making up ~10% algal dry weight. *Dunaliella salina* can reproduce asexually, sexually and through a division of motile vegetative cells.

### **Tetraselmis chuii - Green**

*Thalassiosira pseudonana* is a species of marine centric diatoms. It was chosen as the first eukaryotic marine phytoplankton for whole-genome sequencing

### **Thalassiosira pseudonana - diatom species from red to green.**

*Thalassiosira pseudonana* is a marine centric diatom. Diatoms are unicellular, eukaryotic, phytoplankton that display a unique evolutionary history and provides major ecological contributions in marine environments. Diatoms are capable of photosynthesis, having acquired plastids through secondary endosymbiosis of primary endosymbionts, including

plants and, green algae, red algae, and glaucophytes. Having evolved 91.5 million years ago during the Upper Turonian period [1], analyses of these organisms display long-term contributions to deposits of diatomite, carbon cycling, global climate, and petroleum reserves. Today diatoms continue to have major ecological implications by playing a fundamental role in global carbon cycling and global climate. As a result of the ecological importance of diatoms, *T. pseudonana* was the first diatom to undergo full genome sequencing. In addition, *T. pseudonana* have elaborate silicified cell wall nanostructures that may contribute to the future study of silica nanotechnology. *T. pseudonana* diatoms display a unique combination of metabolic processes including genes for nitrogen fixation, the urea cycle, carbon fixation, iron uptake, and photosynthesis [3].

### **Haematococcus pluvialis** - Green (freshwater and coastal brackish)

3 Major Health **Benefits** of Astaxanthin; Astaxanthin is known to powerfully enhance brain function, eye health, immunity and joint function among other things. The greatest natural source for astaxanthin is in the unique microalgae **Haematococcus pluvialis**. Safety of an antihistamine-rich *Haematococcus pluvialis* algal extract: a randomized clinical trial. A growing body of scientific literature indicates that astaxanthin is a more powerful antioxidant than other carotenoids and vitamin E and may confer numerous health *benefits*. The green algae *H. pluvialis* makes high amounts of astaxanthin when its condition is unfavourable, including high UV exposure, which is why astaxanthin has strong anti-oxidative properties (R).

### **Anabaena variabilis** - Green (freshwater) cyanobacteria

*Anabaena variabilis* is a species of filamentous cyanobacteria. This species of the genus *Anabaena* and the domain Eubacteria is capable of photosynthesis. This species is also known to be heterotrophic in that it may grow without light in the presence of fructose. It also can convert atmospheric dinitrogen to ammonia via nitrogen fixation.

*Anabaena variabilis* is a phylogenetic-cousin of the more well-known species *Nostoc spirillum*. Both of these species along with many other cyanobacteria are known to form symbiotic relationships with plants. Other cyanobacteria are known to form symbiotic relationships with diatoms, though no such relationship has been observed with *Anabaena variabilis*.

*Anabaena variabilis* is also a model organism for studying the beginnings of multicellular life due to its filamentous characterization and cellular-differentiation capabilities.

Animals that eat these microalgae then absorb astaxanthin into their bodies, which is why wild shrimp, lobster, crab, and salmon have bright red-orange colours.