

SOME FACTS ABOUT SPIRULINA

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What is Spirulina?

The name Spirulina comes from a Latin word meaning tiny spiral. Spirulina is the common name for human food and animal food supplements produced primarily from two species of *Cyanobacteria*: *Arthrospira platensis*, and *Arthrospira maxima*. These and other *Arthrospira* species were once classified in the genus *Spirulina*. There is now agreement that they are distinct genera, and that the food species belong to *Arthrospira*; nonetheless, the inaccurate term "Spirulina" remains the popular name (this name is used in this text where it is necessary).

Spirulina is also the scientific name of a cyanobacteria genus rather distant to the *Arthrospira*. Both phylogenetic and morphological analysis illustrate that these microbes are definitely bacteria not being an algae. Therefore, the *Arthrospira* genus is the whole group of edible cyanobacteria sold under the name of spirulina.

The *Arthrospira* are gram negative, a blue-green photolithoautotroph, filamentous cyanobacterium containing one or multiples of ten cells aligned together in a straight line or more or less in spirals. These filaments have a variable length (typically 100-200 microns) and a diameter close to 8-10 microns.

Individual cells multiply in the usual manner via cell fission. The superstructure is the helical multicellular trichome. When the trichome is mature, it breaks up into short cellular chains of 2-4 cells, or hormogonia. These glide away and begin new trichomes.

What differentiates the *Arthrospira* genus from the rest of the cyanobacteria is its ecological niche that this microbe proliferates in very mineralized, alkaline and warm waters. Hardly any other living organism can survive in such conditions.

When it was discovered?

It was first described in 1940, by Dangeard, a French phycologist, who received a sample from a French pharmacologist colleague, Creach, embedded with the French Army in equatorial Africa, near present-day Chad. Creach found little biscuits of the dried bacterial matter being sold in the local market place.

At that time, it was also reported that it was growing on the lakes of Eastern Africa's Rift Valley, and sustaining their huge flocks of flamingos. However, the report went unnoticed and 25 years would pass before *Arthrospira platensis* was rediscovered by the Belgian botanist, J. Leonard. He noticed that the open air village markets of Kanembus at Lake Chad were offering blue-greenish cakes for sale.

Where it exists?

Arthrospira platensis occurs in Africa, Asia and South America, whereas *Arthrospira maxima* is confined to Central America.

Arthrospira platensis grows in shallow alkaline ponds and soda lakes, where the pH is in the range of 9 to 11, and the salt concentration very high, on the order of 38.3 g/L. Such an environment is inhospitable to most other organisms and as such, *Arthrospira platensis* may find itself the only organism of any significance.

The alkaline salts are typically sodium carbonate and bicarbonate which are components of volcanic ash. In terms of photosynthesis, *Arthrospira platensis* is prodigious in its production of oxygen. Rates of 1.2-2.4 g O₂/m²/hr have been reported.

Lake Chitu is the only undisturbed Crater Lake that contains *Arthrospira platensis* in Ethiopia. Moreover samples taken from the lake remain remarkably homogenous and don't have any other cyanobacteria than *Arthrospira*.

No one fruit, vegetable or meat can provide everything the human body demands, but spirulina comes so close to this ideal. Spirulina is the richest of all living foods known.

Spirulina was understood in Chad, as far back as the 9th century Kanem Empire. It is still in daily use today, dried into cakes called "Dihe" which are used to make broths for meals, and in addition sold in markets. Dihe was the hardened product of *Arthrospira platensis*, which was collected from mats floating on small lakes or ponds, dried, and broken into pieces for sale. Spirulina is also thought to have been a food source for the Aztecs in 16th century Mexico, as its harvesting from Lake Texcoco. Today Spirulina is consumed by millions of people all over the world.

Besides lots of clean air and water, the human body needs essential nutritional elements in order to survive, all of which are abundantly present in spirulina. These elements include proteins, carbohydrates, lipids (fats), vitamins, minerals, enzymes and pigments (for further information see table 1 and 2)

Uses

Table 1. Nutritional Composition of the world's best complete food-Spirulina

Content	Ratio
PROTEIN (by dry weight)	50-77 %
CARBOHYDRATES	15-25 %
LIPIDS (FATS)	6- 8 %
FIBER	8-10 %
VITAMINS per 10 g	
A	23000 IU
B1	0.35 mg
B2	0.40 mg
B3	1.4 mg
B6	80 mcg
B12	20 mcg
C	90 mcg

D	1200 IU
E	1.9 mg
K	200 mcg
Beta Carotene	14 mg
Biotin	0.5 mcg
Inositol	6.4 mg
Folic acid	1 mcg
Nicotinic acid	1.18mg
Pantothenic acid	10 mcg
MINERAL per 10 g	
Calcium	70 mg
Iron	15 mg
Phosphorus	80 mg
Magnesium	40 mg
Zinc	0.3 mg
Selenium	10 mcg
Copper	120 mcg
Manganese	0.5 mg
Chromium	25 mcg
Sodium	90 mg
Potassium	140 mg
Germanium	60 mcg
NATURAL PIGMENT PHYTONUTRIENTS per 10 g	
Phycocyanin (blue)	1400 mg
Chlorophyll (green)	100 mg
Carotenoids (orange)	47 mg
NATURAL PHYTONUTRIENTS per 10 g	

Gama Linolenic Acid (essential fatty acid)	130 mg
Palmitic acid	210 mg
Linoleic acid	138 mg
Alpha Linolenic acid	70 mg
Chlorophyll-a	76 mg
Beta Sitosterol	1 mg
Glycolipids	200 mg
Sulfolipids	10 mg
Polysaccharides	460 mg
NATURAL PIGMENTS (CAROTENOIDS) per 10 g	
Carotenes (orange)	25 mg
Beta Carotene	21 mg
Other Carotenes	4 mg
Xanthophylls (yellow)	22 mg
Myxoxanthophyll	9 mg
Zeaxanthin	8 mg
Crytoxanthin	1 mg
Echinenone	3 mg
Other Xanthophyll's	3 mg
AMINO ACIDS per 10 g	
Essential Amino Acids	
Isoleucine	350 mg
Leucine	540 mg
Lysine	290 mg
Methionine	140 mg
Phenylalanine	280 mg

Threonine	320 mg
Tryptophan	90 mg
Valine	400 mg
Non-Essential Amino Acids	
Alanine	470 mg
Arginine	430 mg
Aspartic acid	610 mg
Cystine	60 mg
Glutamic acid	910 mg
Glycine	320 mg
Histidine	100 mg
Proline	270 mg
Serine	320 mg
Tyrosine	300 mg

Table 2. Some of Comparative Nutritional Values

Content	Ratio
Protein g per 100g	
Eggs	13.3
Milk	4.3
Soya bean	43.2
Pulses (black gram)	24.0
Spirulina	55-77
Beta-Carotene mcg per 100g	
Carrots	1890
Spinach	5580
Mango	2740

Spirulina	190000
Vitamin B₁₂ mcg per 100g	
Milk	0.60
Spirulina	5
Iron g per 100g	
Soya bean	11.5
Spinach	10.9
Spirulina	32

When we see to health benefits of spirulina, studies are showing that it may exhibit antiviral, anticancer, antimicrobial, and anti-inflammatory activity. It has also been shown to have beneficial effects on controlling cholesterol, diabetes, coronary artery disease, weight loss and wound healing.

How is it used?

Spirulina is used as a human food and food supplement, available in powder, tablet, cake, biscuit and juice form. It is also used as a feed supplement in the aquaculture, aquarium, and poultry industries. Waste from the production can even be used to make bioplastics.

Spirulina production and processing in Ethiopia

Ethiopia, with enormous natural resources, has been wounded by drought and famine. However, the country could have the potential to produce abundant food for its people. One of these natural resources is *Arthrospira platensis* after which Ethiopia is recognized as one of the home countries for the "food of the future", supplier of the best food.

Even so, after more than 20 years, since harvesting of spirulina from lakes in Ethiopia was proposed, practically nothing has happened. I strongly believe that in the near future, spirulina will be a primary solution to eradicate malnutrition and hunger from our country!