Research for Progress, Not for Profit!

Who are we?

Fighting against malnutrition

The Declaration of Human Rights assures each human being the right to nourishment, health and lodging….

…. Today, more than one third of worldwide population is still deprived of the basic right to nourishment.

More than starvation, the real challenge today is malnutrition: the deficiency in micro-nutrients (vitamins, minerals and essential amino-acids) that no longer allows the body to ensure growth and maintain its vital functions (**WHO** 1996).

UNICEF estimates that malnutrition kills 13 million children per year, i.e. 36,000 per day. More than 230 million children under 5 years are affected. Malnutrition results in significant delays in physical and intellectual development and reduction of the immune systems leading to lethal infections.

Antenna Technologie's Action

Malnutrition can only be overcome by allowing deprived populations to reach autonomy in local food supplies by developing sustainable diversified production covering essential nutritional needs.

Creating such autonomy requires the simplification and transfer of existing technologies from developed countries to make them accessible and suitable for deprived populations.

Antenna Technologie develops and implements appropriate technologies allowing local development of agricultural production, food supply and related sanitation covering basic essential needs of deprived populations and young children.

Antenna Technologie develops its programs in two phases

Phase 1 Scientific research & development

- Local spirulina production systems
- Large scale spirulina production systems
- Clinical tests on spirulina effects
- Other research : phytotherapeutic cultures, development of seed ranges adapted to tropical family gardens.

Phase 2 Communication, training and on-site applications

Around one hundred people trained by Antenna Technologie are currently working on pilot production sites in India, Africa and South America. Thousands of children are daily given spirulina produced on those sites. To ensure sustainable autonomy of each project, Antenna Technologie systematically works in partnership with well established local NGOs.

Antenna Technologie is organized in a flexible structure

1. A head office with 3 permanent staff assuring the management and coordination of programs in Geneva. It manages relations with International Organization (**UNICEF**, **WHO**, FAO) and large NGOs.
2. A Scientific Network : research & development are carried out by an international network of 30 top level scientists, with multiple and complementary skills working on appropriate technologies development.
3. Pilot Projects : implementation of pilot site and local training are handled by a network of skilled technical staff in conjunction with local authorities or organizations.

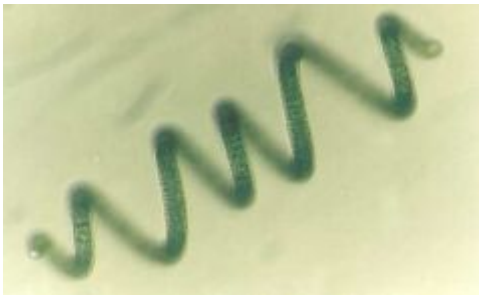
Public & private financial resources

Antenna Technologie is financed by the Swiss Government (Dept. of Cooperation & Development – DDC), the Canton of Geneva, foundations, companies and private donors.

All Antenna Technologie projects shall aim for financial autonomy and sustainability in the medium and long term. To ensure transparency, Antenna Technology always proposes that its donors financially support a specific program or a specific production site, for which donors receive regular reporting.

Research for Progress, Not for Profit!

An answer to malnutrition



Spirulina can be used as a highly effective food supplement to combat malnutrition
This aquatic micro-organism takes the form of tiny green filaments coiled in spirals. It contains a number of micro-nutrients in a form that can be easily absorbed by the human organism. In particular, **spirulina** is rich in beta carotene (of which vitamin A is formed), iron, vitamin B 12 and gamma-linolenic acid. Spirulina is a traditionnal food in Chad.

A daily intake of just a **few grams** of **spirulina** greatly improves the efficiency of traditional nutrition programmes, as has been demonstrated in clinical tests conducted in India and in Central Africa.

Antenna has developed new technologies of spirulina production. In field projects carried out during a number of years, the organisation has tested simple 4m2 and 20m2 spirulina basin.

Antenna provides beginners with documentation and a selected strain of spirulina. One 20m2 basin produces up to 200 g of dried spirulina per day , which is enough to greatly improve the nutritional status of more than 150 children.

Research for Progress, Not for Profit!

Scientific background

General notes on the cyanobacteria

cyanobacteria

The cyanobacteria is a bacteria that is capable of photosynthesis with the production of oxygen. It can be unicellular or multicellular; the later accumulate to colonies or, more frequently, become filaments of cells aligned (these filaments are called trichomes). The size of the cyanobacteria cell is between 1 and 10 microns. Its wall is classic Gram-negative. It is a true procaryotes (an organism without a nuclear membrane), for it contains chlorophyll-a and a photosytem II (PS-II) - despite the similar photosynthesis system as the eucaryotes. This photosystem as well as the photosynthetic, the assistant pigments and those that constituent the

transport of electrons are included in the thylakoide membranes containing granules called "phycobilisomes". These granules contain an essential pigment that transports energy to the PS-II, the phycocyanine: a protein belonging to the prosthetic group of the polypyrrole type which has a magnificent blue colour, as well as an exceptionally effective fluorescent red.

These cyanobacterias assimilate carbon via the Calvin cycle and stock energy and carbon in the form of glycogen. The cyanobacteria varies considerably in it metabolical scheme, it lacks the complete Krebs cycle. Many cyanobacterias, especially among the filamentous, are capable to reduce (to fix) the atmospheric nitrogen due to their special heterocyst structure. The majority of cyanobacterias are capable to move, either with the aide of gaseous vesicles (in the liquids) or, in the case of the filamentous cyanobacterias, by sliding (up to 25 microns per second) due to the micro-fibres. They can reproduce by simple or multiple cell division, by budding or even by random fragmentation. With certain species the specialised cells (akinetes) can resist dehydration and "germinate" when conditions become favourable again.

Spirulina or Arthrospira?

Spirulina:

1. It is the commercial name of an eatable cyanobacteria still belonging to the Arthrospira family.
2. It is also the scientific name of a cyanobacteria genus rather distant to the Arthrospira. For example one knows the Spirulina subsalsa, the Spirulina major, etc. No cyanobacteria of the Spirulina genus has scientifically been tested as a source for nutrition nor does there exist a market for it. Spirulina is a filamentous cyanobacteria containing many multiples of ten cells aligned together in strong spirals. These spirals are often so "tight" that they look like variable long sticks (typically 200-300 microns) and with a diameter close to 5-6 microns (the filament "unrolled" would have a diameter of 2-3 microns).

Arthrospira:
Is the scientific name of a cyanobacteria genus rather distant to the Spirulina genus (much closer for example to the Lyngbya genus). The Arthrospira genus is the whole group of eatable cyanobacteria sold under the name of spirulina. The Arthrospira are filamentous cyanobacteria 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.

Taxonomy of the Arthrospira within the cyanobacteria

Antenna Technology with the collaboration of the University of Geneva has classified the different cultivated and at times eaten stocks of Arthrospira known around the world. This work, which bases its analyses on a fragment of a hyper-variable DNA specific to the cyanobacterias, has showed a very strong homogeneity indifferent of origin or morphologies. We could show that the closest genus to the Arthrospira is the Planktothrix and the Lyngbya genus.

The method developed for this research was also of great help to control the quality of "spirulina" production. The systematic analysis of cultivated samples from different parts of the world has never shown a contamination from other cyanobacterias, which shows the ability of the culture (very alkaline) to protect itself. Even samples taken from "spirulina" grown naturally as the "dihé" from Chad (see "History of spirulina") remain remarkably homogenous and don’t have any other cyanobacterias than Arthrospira.

A **table can be seen here** with the classification of twenty "spirulina" (Arthrospira sp) samples following the genetic sequence of a DNA fragment including the area lying between two genes of phycocyanine (cpcB-cpcA spacer).

Biology of the Arthrospira

What distinguishes the Arthrospira genus from the rest of the cyanobacterias is its ecological niche: its microorganism proliferates in very mineralised, alkaline and warm waters. Hardly any other living organism can survive in such conditions. The Arthrospira development in such an environment excludes other organisms due to three phenomena:

1. By feeding on the carbonates and bicarbonates of its environment the Arthrospira increases the alkalinity of the water - up to a pH of 12.5!
2. As the Arthrospira filaments are very pigmented and often float they form a very effective shield against sunlight, which would otherwise enable algae (as chlorella, an eatable microalgae that sometimes proliferates in low concentration spirulina cultures).
3. It was demonstrated that the Arthrospira is capable to discharge defence molecules. Amongst these molecules one is very active against a waste range of bacteria. This could explain the traditional use of "spirulina" plasters on gangrene wounds (Chad).

Physio-chemical composition of the Arthrospira

Not being an algea but a bacteria the "spirulina" is no cellular wall. This has an enormous advantage from a nutritional point, for hence the microorganism is very easy to digest by human beings. It is perfectly assimilable without the need to be treated in any way. Thus the most fragile formations (vitamins, essential acid fats, etc.) are available without degradation, especially when "spirulina" is eaten raw, which is very much recommended wherever possible (directly on the production sites).

More detail is to be found under "The nutritional aspects of Spirulina"