

# Chlorella

**The sun-powered  
supernutrient  
and its beneficial  
properties**

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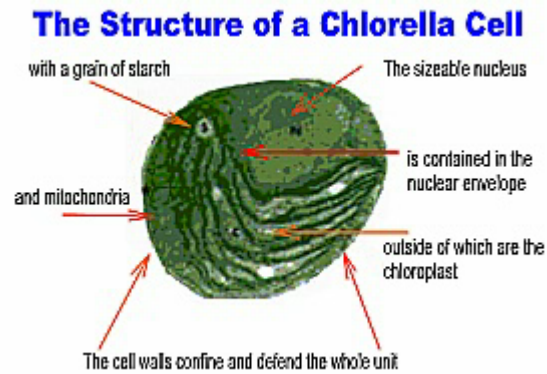
## **What Is Chlorella?**

Nature's abundant storehouse of plants and animals has given us many treasures to be converted into nutrients and medicines. But scientists have only scratched the surface in uncovering potential life-saving ingredients among the earth's flora and fauna. For example, thousands of plants and animals remain unidentified in the remote Amazon rain forests, their beneficial potential untapped.

Until recently, the study of medicinal and nutritional plants was on the decline because pharmaceutical companies- which had worked so energetically to isolate vitamins and other substances from the 1920's to the 1950's- turned their energies into producing synthetic chemicals. The reason was obvious: synthetic substances could be patented and earn the company huge profits. Even of the \$8 billion spent on prescription products annually in the United States, only 22 percent is allocated to products derived from the plant kingdom.

One of the plants arousing interest among researchers for its health potential is chlorella. This single-celled, fresh-water alga is one of the earliest forms of life, approximately two billion years old; it and other forms of green algae are critical to life, participating in photosynthesis, the process responsible for removing poisonous carbon dioxide from the atmosphere and producing the massive amounts of oxygen that are required by all animal life.'

Chlorella, which is roughly the same size as a human blood corpuscle, was discovered in 1890 by a Dutch microbiologist, M. W. Beijerinck, who studied the algae from a small pond under a microscope. His fascination with the question of why sweet-water ponds turned a deep green led to the discovery of chlorella, which is rich in green-pigmented chlorophyll.



Its name is derived from the Greek word chloros, "greenish-yellow," and the Latin ending -ella, "small." One chlorella cell is only 5 microns (.000195 inches) in diameter, but is a well defined plant with a nucleus and a full complement of nutritious and health-building substances.

It has been speculated that chlorella may be the first link in the food chain' as the first one-celled plant with a distinct nucleus inside its cell wall. If it really is Earth's first green

plant, other forms of life could not have evolved without it.

**The Little Green Cell Simple-appearing though it is, each chlorella cell is a complete individual with a well-defined structure. The sizeable nucleus is contained in the nuclear envelope, outside of which are the chloroplast and mitochondria, with a grain of starch off in the "northwest" quadrant; the cell walls confine and defend the whole unit.**

During Earth's first billion or so years of existence, the atmosphere consisted of deadly gases-such as ammonia, methane and carbon dioxide. It became the role of green plants such as chlorella to transform this lethal soup into an environment which could support plants and animals

Chlorella is so small that it cannot be seen without a microscope; a single cell is 6/1000 millimeters across. It reproduces at a rapid rate though. A single cell can divide and subdivide into four cells every 16 to 20 hours. At that rate, a single cell could in 63 days generate enough chlorella to equal the volume of the earth. Fortunately, there are natural elements which limit its reproduction.

It requires substantial sunlight, and if the "crop" becomes too large for the available space, its reproduction rate simply slows down. Because of its rapid growth, a relatively small space needed to grow it, and its abundance of nutrients, chlorella offers researchers many potentials for improving our health. It has been shown to be useful in:

- strengthening our immune systems
- accelerating the healing of wounds, injuries and ulcers
- helping to protect us against toxic pollutants
- normalizing digestion and bowel function
- stimulating growth and repair to tissues
- retarding aging
- protecting us against radiation

The chlorella cell split four ways and quadruple its numbers; this happens every 16 to 20 hours.

## **A Super Protein Source**

Since chlorella is almost 60 percent protein, and since it is able to produce this protein 50 times more efficiently than other protein crops, this unassuming alga could well serve as a valuable protein source in the developing countries, as well as in other areas of the world where the population is outstripping available land.

Because of the small space needed to grow chlorella, it yields about 40 tons per acre. This same acre can only produce about a half a ton of soybeans per year. And soybeans are only 39 percent protein. The most popular food grains, wheat (10 percent protein) and rice (7 percent) provide correspondingly less protein per acre.

Chlorella contains all eight essential amino acids, the constituents of protein. Its amino acid content compares favorably with that of animal-derived protein, except that it has a slightly lower amount of methionine.

It contains impressive amounts of vitamin C, beta-carotene (provitamin A), B1, B2, B6, B12, niacin, pantothenic acid, folic acid, biotin, choline, inositol, PABA, vitamin E and vitamin K. Its mineral content includes phosphorus, potassium, magnesium, sulfur, iron, calcium, manganese, copper, zinc, iodine, and cobalt. It is also a source of lipoic acid, an important microbial growth factor.

During World Wars I and II, German scientists investigated chlorella as a wartime food source. After World War II, the Carnegie Institute, using the initial German research, developed a method of growing chlorella on a commercial basis. However, commercial production never materialized, probably because of the abundance of food in the United States and the difficulty of making chlorella products digestible.

One reason chlorella has been around for two billion years is its strong cell walls, which armor it against all sorts of perils. They also, however, make it hard for human beings to digest it, and a valuable source of protein was for a long time denied to a world in which malnutrition is a serious problem, both in the Third World and in the developed countries among such groups as the poor, the old, those in ill health, and even health-conscious people who go overboard on dieting.

In the 1970s a Japanese firm devised a means of breaking down the cell walls without removing them from the product (the Dyno-Mill process) the disrupted cell walls are an important source of nutrients. This process increased the digestibility of chlorella to up to 85 percent. Other methods in use include blanching, which produces a digestibility of 50 percent.

Chlorella is now widely available as a food supplement in tablet, granule or liquid form, and is digestible enough to be prescribed for infants; it is particularly popular with pediatricians in the Far East.

## **Growth Stimulator**

In the early 1950s, Dr. Fujimaki of the People's Scientific Research Center in Tokyo separated a substance from a hot-water extract of chlorella by electrophoresis (electrically induced movement of suspended particles through water). This hitherto unknown fraction of chlorella was found to be rich in nucleic factors and was named Chlorella Growth Factor (CGF).

Early experiments with young laboratory animals (rats, rabbits, pigs and chicks) showed that adding 5 to 10 percent of chlorella to the regular feed brought dramatic increases in weight gain and size. These gains ranged from a low of 10 percent to a high of 47 percent compared to control groups.

Dr. Yoshio Yamagishi received permission from the authorities to try chlorella on human volunteers. They were healthy ten-year-old students, 22 boys and 18 girls, studying at Okuno Primary School in Tokyo. Another group of the same age and composition served as controls.

The height and weight of all the children were recorded on a regular basis. At the end of the experiment in which the test group received two grams of chlorella daily (except on Sundays) for 112 days, the average increase for boys taking chlorella was one inch in height and 2.3 pounds in weight.

The boys in the control group grew 0.6 inches in height and gained 1.6 pounds in weight.

The girls of both groups gained an average of 0.9 inches in height, but the girls who took chlorella gained an average of 4.2 pounds, while the controls gained 2.7 pounds.

This capacity to promote growth in the young is apparently related to chlorella's ability to stimulate the healing process in the body and work against many disease states-probably due to its nucleic acid content more than anything else-since the same substances and process that accelerate growth in the young promote repair of damaged tissue in mature animals and humans.<sup>2,3</sup>

## **Can Chlorella Retard Aging?**

Since Chlorella Growth Factor is so effective in stimulating growth in human beings and in beefing up the immune system to fight off various diseases, Dr. Bernard Jensen and other researchers have wondered whether or not Dr. Benjamin Frank's<sup>4</sup> pioneering work on aging might apply to chlorella.

Dr. Frank believed that the loss of energy and physical deterioration associated with aging was due to the increasing breakdown of nucleic factors (DNA, RNA) which are needed to keep the cells healthy.

He theorized that, as we age, our natural production of RNA and DNA become sluggish, possibly around age 20. To counteract this drop in the efficiency of cellular reproduction, which could, of course, affect how long we will live, Dr. Frank put his patients on a diet rich in DNA and RNA foods. He expected an improvement in energy levels and wellbeing as the nucleic components were made available for repair and replacement of cellular nucleic acids. DNA and RNA in all living things are made up of the same basic chemical building blocks.

Dr. Frank found that his treatment actually did help his patients regain energy and a more - youthful appearance. In addition, long-standing problems with arthritis, memory loss and depression began to abate. He recommended the use of such high-RNA foods as canned or fresh sardines, salmon or other seafood, legumes, wheat germ and green leafy vegetables. Canned sardines are thought to be among the highest sources of RNA at 590 milligrams per 100 grams.

Since Dr. Frank's research was published, it has been determined that chlorella has several times the nucleic acid content of sardines. Chlorella also reportedly provides nucleic acids that are more readily available to the body than supplements made from synthetic sources.

## **Chlorella and Immunity**

The immune system is our first line of defense against disease, whether infectious or degenerative. It is only when it weakens or fails that even mild diseases such as cold, and of course grave ones such as cancer, gain a foothold. Studies have indicated that Chlorella can have a significant stimulating effect on the immune system.

A 1973 experiment demonstrated an important aspect of chlorella's immunostimulative properties. Rats injected with a chlorella extract produced macrophages (a key element in the immune system) which showed increased activity in taking up harmful foreign particles.<sup>5</sup>

Antitumor activity linked to stimulation of immune system elements was demonstrated in experiments reported to a 1985 immunology conference in France. The researchers concluded that the chlorella derivatives used enhanced macrophage activity and the cell-destroying ability of certain lymphocytes. They speculate that the antitumor effect noted may be a "synergistic effect of activated macrophages and cytotoxic T cells.... But we think that the antitumor effect ... is mostly dependent upon the enhancement (or restoration) of macrophage activity."<sup>6</sup>

Mice with artificially depressed immune systems were brought to nearnormal values for macrophage activity and number of antibody-producing cells with the administration of chlorella extract. The effect on survival time was particularly impressive, with almost all of the untreated mice dying before the first of the treated animals succumbed.<sup>7</sup>

In humans, immune system resistance to cold viruses was shown in a group of approximately 1,000 Japanese sailors in 1971. Roughly half the men got two grams of chlorella a day, the others none. At the end of the three-month cruise, the untreated sailors had had 41 percent more colds than the chlorella-takers.<sup>7</sup>

Chlorella's antioxidant properties are important in immune system function, and are discussed in detail in the section on beta-carotene.

## **Digestion is Improved**

Bowel detoxification and bowel health are also in chlorella's domain. The cell wall material included in natural chlorella products has a highly important effect in the intestines: it has the capability of improving bowel function, it stimulates the growth of aerobic, friendly bacteria, and the cell walls act to absorb poisons within the intestine and promote normal peristalsis. The intestinal tract, especially the small intestine, is lined with patches of lymphocytes which are stimulated by chlorella to destroy foreign invaders such as anaerobic bacteria.

Peristalsis is the muscular contraction that moves material through the bowels. This normal movement prevents constipation and also plays a part in preventing toxic material in the stool from being reabsorbed into the bloodstream.

By stimulating the growth of beneficial bacteria, chlorella promotes bowel health. Besides helping to prevent constipation, these bacteria fight off infections, help detoxify some potentially poisonous substances in our food and even manufacture some of the vitamin B12 we need. The ability of chlorella to stimulate the growth of beneficial bacteria and to detoxify chemicals can be put to good use by persons suffering from a *Candida albicans* infection.<sup>1</sup>

## **Chlorella's B12**

Vitamin B12 has perhaps the most complex chemical structure of all the vitamins, and is not readily available in the diet. It is found in great quantities in beef liver and muscle meats and in lesser amounts in milk and cheese. Chlorella is a reliable source of B12, since it has more of the vitamin than liver. One tablespoon of chlorella provides 333 percent of the RDA of B12 for adults.<sup>9</sup>

This is especially welcome news for pure vegetarians (vegans), who are often deficient in B12 and therefore face the possibility of developing pernicious anemia. In addition, B12 works with folic acid in maintaining healthy cells, and adequate amounts of these nutrients promote a sense of wellbeing.

Dr. Anthony Helmen and his colleagues at the University of Sydney in Australia studied 60 men and 60 women who had become vegetarians. It was found that 5 percent of the males and 27 percent of the females were deficient in iron, and that all of the volunteers had borderline low levels of vitamin B12.<sup>10</sup>

## **Chlorella's Beta-Carotene**

Chlorella contains 180 mg of beta-carotene in each 100 grams. Beta-carotene has the greatest vitamin A activity and antioxidant activity of all of the known carotenoids. Beta-carotene has two potential mechanisms to lower the free radical burden in the body, and it is one of the most powerful singlet oxygen quenchers. It can dissipate the energy of singlet oxygen, thus preventing this active molecule from generating free radicals. It can also act directly as an antioxidant and scavenge free radicals generated by reactions other than those involving singlet oxygen.

Beta-carotene, synthesized in chlorella, can protect us from singlet oxygen damage due to photo-oxidative reaction. People with light-sensitive skins can also use beta-carotene to help protect their skins from photo-oxidative damage.

Although singlet oxygen is found only in small concentrations in air pollution, it does pose a significant health risk. Beta-carotene's protective effect against UV radiation is being studied extensively by Andrija Kornhauser, Ph.D. of the Food and Drug Administration, Washington, D.C. His most recent studies were discussed at the 1987 beta-carotene conference in Boca Raton, Florida.

Theoretically one beta-carotene molecule can provide two molecules of vitamin A activity. The RDA is therefore calculated in the overall utilization of beta-carotene as one-sixth that of vitamin A (retinol).

A 1983 study showed that dietary beta-carotene protected guinea pigs from the free radical damage caused by an injection of carbon tetrachloride. This toxic chemical caused free radical destruction of fats in guinea pigs not fed beta-carotene. The experiment and other work in 1982 clearly showed that beta-carotene can serve as an antioxidant both in the test tube and in the body.<sup>11,12</sup>

The antioxidant function of beta-carotene complements the other antioxidant protective substances such as catalase, glutathione peroxidase, vitamin C and vitamin E. As an antioxidant and singlet oxygen quencher, beta-carotene may protect cells from the carcinogenic effects of free radical damage. Although the exact mechanism for protection by

beta-carotene is not known, epidemiological evidence suggests that individuals whose diets are low in carotene have a greater incidence of lung cancer,<sup>13</sup> stomach cancer, prostate and cervical cancer.<sup>14</sup> There have also been data showing that those who consume high levels of carotene have a lower risk of developing these cancers as well as dying from cancer.<sup>15</sup>

The immune system is as susceptible as any other system in the body to the damage generated by free radicals. If the immune system is damaged to any extent it may lead to an inability to defend against and remove potentially cancerous cells from the body. One of the prime purposes of the immune system is to stop trouble before it starts. Destruction of precancerous cells is one example of this protective function.

Studies done in animal models have shown that beta-carotene can act as a stimulant to the immune system.<sup>16</sup>

With so much research showing the ability of beta-carotene to influence human health, why not just take beta-carotene supplements alone or increase the ingestion of beta-carotene containing foods?

Certainly, both these suggestions have validity. However, there's something called synergy-which helps one plus one equal three!

Drs. Joel Schwartz, Diana Suda and Gerald Shklar of the Harvard School of Dental Medicine reported their research at the 1986 meeting of the American Academy of Oral Pathology in Toronto. They demonstrated a dose-response effect of betacarotene on hamster cheek cancers induced by the use of a carcinogen, 7,12-dimethyl-benzanthracene (as found in tobacco smoke and chewing tobacco).

Extracts of algae were also studied and were shown to be more effective than beta-carotene alone. This result caused the Harvard group to speculate that other factors may give algae more anti-tumor effects than can be accounted for by their betacarotene content. But these results must be duplicated by other researchers before they can be completely accepted by the medical profession. Encouraging pilot studies with AIDS and Epstein-Barr virus patients employing chlorella suggest further effectiveness in immune system stimulation and, when completed, should provide important information.

At a beta-carotene conference sponsored by the Vitamin Nutrition Information Service, and held April 10-12, 1987 in Boca Raton, Florida, a number of researchers discussed the value of beta-carotene in treating and preventing a variety of cancers.<sup>17</sup>

Marilyn S. Menkes, Ph.D. of Johns Hopkins University in Baltimore said that studies have shown that populations with higher beta-carotene intakes have lower rates of lung cancer, and those groups with less betacarotene in their diets have a higher cancer rate. In a controlled study involving 99 people with lung cancer and 196 volunteers who did not develop cancer, Dr. Menkes and her colleagues studied the levels of betacarotene and other nutrients in blood samples. They found that those with low blood levels of beta-carotene had a four times higher risk of squamous-cell carcinoma of the lung than the others tested:

Peter Greenwald, M.D. of the National Cancer Institute in Washington reviewed 14 ongoing studies investigating the role of beta-carotene and other nutrients in the possible prevention of cancer.

A Canadian study headed by Hans F. Stich, Ph.D. should be of interest to the many young men now chewing tobacco. He and his colleagues of the British Columbia Cancer Research Center found that the administration of beta-carotene (or betacarotene and vitamin A) significantly reduced the frequency of cancer cells in snuff dippers in Canada, tobacco-betel nut chewers in India and "reverse smokers" in the Philippines. Dentists in the United States are reporting an alarming increase in the number of lip and mouth cancers among those chewing tobacco or dipping snuff.

Frank L. Meyskens, Jr., M.D. of the Arizona Cancer Center told the conference that epidemiologic data support the notion that "many human cancers are associated with diet, and that laboratory experiments show that cancers can be prevented by dietary alteration or pharmacologic supplementation with certain agents."

One of these agents, he said, is beta-carotene. It is especially promising because: (1) There is a strong inverse relationship for the incidence of some cancers and beta-carotene consumption in many epidemiologic studies; (2) beta-carotene is useful as a cancer preventive agent in experimental animals; (3) it is a strong antioxidant; (4) it is available in vegetable sources and as a drug; and (5) it has very low toxicity even in high doses.

\*As the term indicates, but you probably didn't allow yourself to believe, reverse smokers hold the lit end of the cigarette or cigar *inside* the mouth.

## Chlorella's Chlorophyll

We noted earlier that chlorella's name translates as "little green." Chlorophyll means "leaf-green" (*phyllon* = "leaf") and is what gives chlorella, and all green plants, both their characteristic color and their ability to create energy from sunlight.

Chlorella contains more chlorophyll per gram than any other land or sea plant. Another alga, spirulina, considered a good chlorophyll source, contains 7.5 milligrams of chlorophyll per kilogram; chlorella runs 30 mg/kg, or four times as much.

"Green algae are the highest sources of chlorophyll in the plant world; and, of all the green algae studied so far, chlorella is the highest, often ranging from 3 to 5 percent chlorophyll," says Dr. Bernard Jensen. "Chlorella supplements can speed up the rate of cleansing of the bowel, bloodstream and the liver, by supplying plenty of chlorophyll. In addition, the mysterious Chlorella Growth Factor speeds up the healing rate of any damaged liver."<sup>18</sup>

He adds that, although green, leafy vegetables are a source of chlorophyll, they contain less than half of 1 percent of the substance. Alfalfa, from which chlorophyll is often extracted commercially, has only 8 to 9 pounds of chlorophyll per ton or about 0.2 percent when extracted, even though alfalfa is one of the plants richest in chlorophyll; commercial liquid chlorophyll actually often contains only about 1 percent chlorophyll.

Chlorella's chlorophyll content is important, because it makes an important contribution to chlorella's effect in the body. One example of this is stimulation of erythrocyte (red cell) formation in the blood.

Two University of Liverpool scientists performed several studies on Laboratory animals.<sup>19</sup> In one, induced anemic rabbits were given varying doses of chlorophyll (refined or fresh). The rabbits were able to convert chlorophyll into hemoglobin, thus correcting the anemia. Although the reaction occurred with both types of chlorophyll, the percentage of conversion was higher when the fresh chlorophyll was used.

Chlorophyll is able to influence bacterial and animal growth, metabolism and respiration, hormone action, nutrition, the immune system and a number of disease states. It also speeds the healing of wounds and burns and can act as a deodorant. Chlorophyll and odor control have long been associated. It has been used and documented as effective against bad breath and underarm odor. In nursing homes, chlorophyll is an important aid in controlling the odors of incontinence.<sup>20</sup>

Its high chlorophyll content makes chlorella an effective deodorizing agent. People taking it as a food supplement often find that body and breath odors are greatly lessened. It can also be used in some odor-causing skin conditions, in which the odor is that of bacteria-caused putrefaction. A filtered solution of sterilized chlorophyll powder has been helpful in some such cases, but such a course should be checked with a physician, not tried on one's own.

The first demonstration of chlorophyll's action as a stimulant to tissue regeneration was demonstrated as early as 1930 when Rollet and Burgi showed that green plant cultures were able to stimulate tissue growth in cultures.<sup>21</sup>

In 1943, physicians at a New York medical school studied the action of chlorophyll ointment and aqueous solution on a number of different types of skin ulcers and found that an overwhelming majority of the ulcers (19 of 25) responded favorably. "Chlorophyll had a stimulating effect on the supportive tissues promoting rapid healing."<sup>22</sup>

Other 1940s researchers reported such results as:

- More than 1000 cases of colds and respiratory infections treated and cured with chlorophyll
- 20 cases of colon disorders treated with chlorophyll; most cases showed definite improvement
- 25 percent improvement in wound healing in more than 1300 laboratory animals treated with chlorophyll

(As chlorophyll is loaded with carotenoids, it is interesting to speculate on the extent to which these curative effects are the result of carotene.)

In 1941, Dr. S.L. Goldberg reported on treatment of 300 patients suffering from pyorrhea (bleeding gums and loosening teeth), noting significant improvement. Vincent's stomatitis, a gum infection which occurs most often in persons suffering from stress with an underlying cause of a severe vitamin C deficiency, was also treated by the doctor with chlorophyll. The technique included using a chlorophyll solution as a mouthwash at least twice a day and squirting

chlorophyll between the teeth and around the gum line at least three or four times a day. The squirting can be done with an ordinary eye dropper.

Goldberg noted that the use of chlorophyll resulted in a tightening of the teeth, the cessation of bleeding from the gums and the growth of new tissue to replace damaged tissue.<sup>23</sup>

(The procedure can be approximated at home by purchasing chlorella granules or powder and preparing a solution in water. The solution should be made fresh for each application. Chlorella powder may also be placed on the toothbrush and gently massaged into the gums. As with any dental process, be sure to check with your dentist before attempting any form of self-treatment.)

With these and so many other investigations pointing to the positive effect of chlorophyll, why did it lose popularity for about 30 years?

Disappointed expectations may be the explanation. In 1949, *Reader's Digest* magazine carried an article on the "Mysterious Power of Chlorophyll," and chlorophyll became a vogue. It was added to every product possible from toothpastes to deodorants to medicines. The problem was that the chlorophyll being used by the manufacturing companies was not pure chlorophyll. It was a substance called copper chlorophyllin sodium, made by decomposing natural chlorophyll and binding a copper ion to it. It looked like chlorophyll, it turned green, and it sold products. But it didn't work like chlorophyll. Natural chlorophyll has magnesium in its center. When you substitute a different mineral, you have a different substance with different qualities.

When manufacturers, M.D.'s and the public found that chlorophyll as manufactured didn't live up to the claims made for it, they lost interest in it-and, consequently, in chlorella as a prime source of it.

## **The Unpoisoner**

In Japan, interest in chlorella has focused largely on its detoxifying properties-its ability to neutralize or remove poisonous substances from the body. Japan, with the earliest and most catastrophic experience with nuclear byproducts and growing problem of industrial pollution, as exemplified in the outbreak of the mercury-caused Minamata disease, has a special concern with environmental contamination, and paid immediate attention to early medical journal reports of chlorella's effect on pollutants.

One such test in the United States involved the administration of the poisonous hydrocarbon chlordecone to animals, which were then fed chlorella. The chlorella interrupted the recirculation of the chlordecone and eliminated it from the animals' bodies. The researchers concluded that chlorella was a potentially effective detoxifier for not only chlordecone but for compounds with similar properties, such as dioxin and PCBs.

The presence of such contaminants in the food supply and atmosphere was already seen as a problem requiring solution, and such reports encouraged research in Japan, but it was the studies indicating chlorella's effectiveness against radioactive contamination that really stimulated chlorella production in that country. As early as 1950 a paper in *Experientia* reported that guinea pigs on a diet rich in chlorophyll showed increased resistance to lethal X-rays; the U.S. Army repeated the experiment, with the same results.

A Japanese study of heavy metal poisoning with cadmium revealed that when 8 grams of chlorella were administered to the test animal daily, cadmium excretion increased threefold in the stool and sevenfold in the urine.<sup>24</sup>

A 1986 Scottish study reported that cadmium is accumulated internally in algae as a result of a two-phase uptake process. The first phase involves a rapid physiochemical absorption of cadmium onto cell wall binding sites, which are probably protein and/or polysaccharides, followed by a slow, steady intracellular uptake.

Another example of chlorella's ability to detoxify was shown in a study in which a culture of brewer's yeast was given a lethal dose of four highly toxic substances, mercury, copper, cadmium and PCB. When chlorella extract was added to a mixture of these poisons, the brewer's yeast remained alive.<sup>25</sup>

Chlorella can also detoxify uranium and lead. Many more studies substantiate the ability of chlorella to remove poisonous materials from the body. Interested readers will find further scientific material to support what has been said at their local medical library.

It appears that the detoxification effect is due both to the chlorophyll content of chlorella and to the composition of its cell walls. This is the reason that cell walls are included when chlorella is prepared for sale.

The cell walls of chlorella have three layers, of which the thicker middle layer contains cellulose microfibrils, and the outer layer a polymerized carotenoid material. It is this cellular material which first binds the toxic material to it and then removes it from the body.

With the fallout from the Chernobyl accident expected to be with us, especially large areas of western Europe, for 100 years or more, and an anticipated rise in leukemia deaths around many nuclear plants, it would appear that chlorella is worth investigating as a possible antidote. It was mentioned earlier that beta-carotene, found in great abundance in chlorella, offers protection against the singlet oxygen that is one of the constituents of air pollution, as well as against harmful ultraviolet radiation from the sun. That leaves many other areas open for investigation, such as the potential harm from radon gas

## **Chlorella Is Not Toxic**

Many societies have used plants from the sea and from fresh water as a part of their diet as well as for their medicinal properties. They were used in China, Korea and Japan as early as 3000 B.C. Pythagoras referred to edible species in his dietary theses, and they have been considered staples in the diets of the Aztecs, Vikings, Irish, Scots, Maori and many islanders in the South Pacific.

The FDA's select committee, reviewing the status of algae, stated that seaweeds have been an accepted food in the Far East for centuries, constituting up to 25 percent of the daily diet.

The Huntington Research Center studied green and yellow chlorella for possible toxic effects. Laboratory animals were fed varying amounts and, although no toxic dose was ever reached, the researchers concluded that a person could sicken if he or she ate a kilogram (2.2 pounds) of chlorella at one sitting.<sup>27,28</sup>

(Of course, if you ate a whole kilo of any one of a number of foods at one sitting, you would be likely to suffer severe discomfort at the very least. Think about 2.2 pounds of peanut butter.) In other words, no toxicity was found at the highest doses of chlorella tested.

Human volunteers have followed a dietary regimen with chlorella as the only protein source for three weeks, without any ill effects.

Directions usually appear on the bottle or package of chlorella. Generally, the maintenance dose is 1 to 5 tablets (or the equivalent amount of granules or powder) three times a day with meals.

For detoxification, tablets or granules should be taken on an empty stomach.

It is possible that the initial reaction may be an increase in the amount of abdominal gas released. This will cease as the system is restored to normal activity.

In general, allow three to four weeks for chlorella to produce the desired results. Constipation and bad breath/body odor can show a noticeable improvement within 7 to 10 days.

## **It's Not Spirulina**

The appearance of spirulina tablets in the marketplace has caused some consumers to confuse them with chlorella. Since spirulina in its dry, powdered form is green, it is difficult to distinguish between chlorella and spirulina. Green tablets, of course, further confuse the public. Spirulina has its place in the supplement market, but it should not be confused with chlorella.

Spirulina is a multi-cell, spiral-shaped plant, whereas chlorella is a round, single-cell alga. Spirulina does not grow in fresh water; it requires brackish or salty water. Also, spirulina does not have the specialized cell walls found in chlorella, nor does it contain as much chlorophyll. In fact, chlorella contains five times as much chlorophyll as spirulina.

## **Case Histories**

As indicated earlier, chlorella has been used successfully for a variety of illnesses. In Japan alone, during the past 20 years, over 4 million people have used chlorella, either as self-medication or as prescribed by their doctors. Here are some illustrative clinical studies reported by the Saito Hospital in Fukuoka.<sup>29</sup>

**Case No.1.** A 27-year-old male was admitted to the hospital and diagnosed as having stomach ulcers and chronic pancreatitis. For the previous two years he had complained of a bloated feeling and a loss of appetite. Shortly before he was admitted, he began vomiting blood

A preliminary X-ray examination revealed an enlarged duodenum and there was a niche in the lesser curvature of the stomach. A stomach camera confirmed ulceration in this region. His stomach fluid registered a high acidity.

The physicians prescribed chlorella, which the patient took for 50 days. After three weeks, he reported that his symptoms had disappeared. About a month later, the physicians determined that the niche was very small and that the ulceration had begun to heal.

**Case No.2.** Upon examination, a 45-year-old man was found to be suffering from duodenal ulcers and chronic inflammation of the stomach. He had had a "weak stomach- since birth, but reported that in recent days the pain had become more intense, and he had vomited frequently. A camera view of the stomach revealed hypertrophic gastritis and hidden blood in the urine. The drug Mesaferin and other medications had not been effective. However, his condition rapidly improved seven days after he began taking chlorella. After 25 days of the algae his symptoms had virtually disappeared.

**Case No.3.** A 24-year-old man was admitted with chronic gastritis and severe inflammation of his gallbladder. He had complained of heartburn for almost a year. Four months of treatment with the usual therapy had been unsuccessful. An X-ray showed that the duodenal bulb was deformed, and the resulting pressure was contributing to the pain. The gallbladder bile was quite cloudy. After taking the prescribed chlorella tablets for 40 days, the subjective symptoms had virtually disappeared.

Patients with difficult-to-treat injuries and infirmities were prescribed chlorella tablets and extract by the Iguchi External Medical Class in the medical facility at Kyushu University. A 39-year-old woman with acute myelitis or swelling of the spinal cord, experienced a loss of mobility and numbness of both legs. This resulted in an obstruction of the bladder and rectum. During the eleventh day of her hospital stay, she developed large bedsores, especially on the sacrum, trochanter and right heel. During six months of therapy with antibiotics, vitamin B and a drug, the sores on the trochanter and heel began to fade. But the bed sore on the sacrum remained rather large, and a swollen malignant granuloma was found.

The physicians decided to give her chlorella tablets, along with the previous therapy; and, after 50 days, the sacrum bed sore was somewhat improved. They switched her to a chlorella extract, and, after only three days, the bed sore on the sacrum was less than half the size it was originally, and there was a reduction in the discharge from the granuloma. The swelling was also noticeably reduced.

Dr. Takuma, a pediatrician, reported the case of a five-month-old boy who had a heavy rash on his head and neck because of an allergic reaction to cow's milk. The infant was given a substitute "milk" of chlorella for 27 days; there were no noticeable side effects, such as diarrhea. On the seventh day of this therapy, the rash began to subside and it was completely gone by the tenth day. After the baby was again given cow's milk, the rash returned the following days.

Another five-month-old boy, also allergic to cow's milk, had an unsightly rash on his face, ears, forehead and cheeks. Cortisone cream had been ineffective. When the infant was given soy milk, his stools became watery and he had seven or eight bowel movements per day. The doctor switched the boy back to cow's milk and his condition worsened. As with the previous baby, a chlorella extract brought complete relief from the rash in 10 days,

At another hospital, an 18-year-old man was admitted following a traffic accident. The skin of his left forearm was scraped away during the accident and had become infected. His head was cut open, he had a fractured pelvis, and there were various bruises over his entire body. Conventional therapy for three weeks failed to heal the forearm. After chlorella was administered, healing began within four days. After three weeks of taking chlorella, the physicians reported that the wound was reduced to three-fifths of its original size and the granulation was judged to be benign. Following six weeks of chlorella treatment, and three weeks of skin grafts, the wound was completely healed.

Dr. Tchamura of Toyama University gave 30 chlorella tablets per day to five patients with itai-itai, the "ouch-ouch" disease caused by mercury poisoning and other kinds of pollution. He reported that the patients with second-degree symptoms experienced less pain in their joints after one week on this therapy. He also said that the patients were excreting larger than usual amounts of cadmium in urine and feces.

Chlorella is useful in alleviating chronic constipation, according to Dr. Saito and other researchers. He recalls a 59-year-old man with paralysis of all limbs, which was due to the fracture of the third cervical vertebra and complicated by an

injury of the cervical medulla. Unable to walk, he soon developed chronic constipation and an inflation of the abdomen. An enema was required every few days. However, after he was given chlorella, his bowel movements became regular each day.<sup>31</sup>

Another patient, a 48-year-old man, was diagnosed with liver cirrhosis, abdominal inflation and dropsy. He complained of gas and constipation. Chlorella tablets not only improved his appetite but also increased the discharge of gas, and he had a regular evacuation daily.

Dr. Sonoda did a double-blind study of 58 women between the ages of 45 and 55 who had various menopausal complaints. Half were given chlorella and the remainder a placebo. He reported that chlorella had an especially remarkable effect on constipation, sweats and fatigue. And he noted that, if two of the symptoms disappeared quickly, the third symptom would go away after a short time

At the Nutritional Clinic in Tottori City, Dr. Tokuyasu gave 10 grams of chlorella daily (containing approximately 7 milligrams of iron) to a group of high school students who had been diagnosed as anemic. He also recommended a balanced diet. After four months on this therapy, 83 percent of the students were found to be no longer anemic.

## Conclusion

It is remarkable that chlorella, so tiny that it has to be seen under a microscope, offers so many health benefits to mankind. Originally investigated for its potential in helping to solve the world hunger problem because of its high protein content-and its ability to produce its protein about 50 times more efficiently than other protein crops -chlorella has developed into one of the finest health food supplements available.

Although researchers around the world are unable to pinpoint the exact ways that chlorella is able to detoxify pollutants and heal wounds as well as restore good health to a variety of patients-it is logical to assume that other ingredients besides protein/amino acids are the reason. In addition to its storehouse of chlorophyll, which in itself offers many health benefits, chlorella is a reliable source of vitamin B12, beta-carotene, vitamin E and other essential vitamins and minerals

It should be noted that, while much of the research discussed has been done in Japan, a great deal of interesting and important work is now being done in the United States.

The Chlorella Growth Factor that has been isolated in chlorella confirms Dr. Benjamin Frank's original theories on aging. And chlorella's RNA content (many times that of sardines, one of the richest alternative sources) has stimulated faster, healthier growth in children and appears to be the same process which stimulates tissue repair in adults.

Even the few case histories reported here confirm the effectiveness of chlorella in healing various types of wounds; in lessening some of the complaints of menopausal women; in substituting for cow's milk in infants allergic to milk; in removing toxic metals from the body; in correcting chronic constipation; in helping to alleviate the common cold; and many other arresting applications.

These results are not folklore, tales, or testimonials from satisfied users. They are studies done in the best scientific manner by some of the most concerned and brilliant medical researchers

## References

1. Jensen, Bernard, Ph.D. *Chlorella: Gem of the Orient*: Escondido, California: Jensen Publications, 1987.
2. Yamagishi, Yoshio, et al. School children's growth and the value of chlorophyll. *Nihon Iji Shimpo* 2196 (1961).
3. Kollman, H.V. and Schmidt, R. Algae, the modern manna? *Let's Live*, Dec. 1978.
4. Jensen, op. cit
5. Kojima, M. et al. A new chlorella polysaccharide and its accelerating effect on the phagocytic activity of the reticuloendothelial system. *Recent Adv. R. E. S. Res.* 13:11, 1973.
6. Yamaguchi, N. et al. Immunomodulation by single cellular algae (*Chlorella pyrenoidosa*) and anti-tumor activities for tumor-bearing mice. Paper presented at the Third International Congress of Developmental and Comparative Immunology, Reims, France, July 7-13, 1985.

7. Hisada, M. et al. Effect of chlorella administration upon the total lifespan and other physiological status of normal and congenital diabetic mice Kanazawa Medical University Serology School, Kanazawa, Japan, 1987.
8. Smith, L.W. and Spaulding, E.H. The bacteriocidal and bacteriostatic action of water soluble chlorophyll upon standard pathogenic cultures. *Am. J. Med. Sci* 207:647 (1944).
9. Bewicke, Dhyana and Potter, Beverly A., Ph.D. *Chlorella: The Emerald Food*: Berkeley: Ronin Publishing, 1984.
10. *Am. J. Clin. Nutr.*, p. 785, April 1987.
11. Kunert, K.J. and Tappel, A.L. The effect of in vivo lipid peroxidation in guinea pigs as measured by pentane and ethane production. *Lipids* 18:271-274 (1983).
12. Krinsky, K.J. and Deneke, S.M. Interaction of oxygen and oxy-radicals with carotenoids. *JCNI* 69 (1):205-210 (1982).
13. Bjelke, E. Vitamin A and human lung cancer. *Int. J. Cancer* 15:561-565 (1975)
14. Hirayama, T. Diet and cancer. *Nutr Cancer* 1:67-81 (1979).
15. Golditz, G.A et al. Increased green and yellow intake and lowered cancer deaths in an elderly population. *Am. J. Clin Nutr* 41:32-36 (1985).
16. Bendich, A. and Shapiro, S.S. Effect of beta-carotene and canthaxanthin on the immune responses of the rat (in press).
17. Vitamin Nutrition Information Service, Nutley, New Jersey. *Proceedings of Beta-Carotene: A Health Communicators' Conference*, Boca Raton, Florida, April 10-12, 1987 (in press).
18. Jensen, op. cit.
19. Hughes, J.H. and Latner, A.L. Chlorophyll and hemoglobin regeneration after hemorrhage. 1. *Physiol.* 86: 388-395, (1936).
20. Young, R.W. and Beregi, J.S. 1. *Am Ger. Soc.* 1:46-47 (1980). 21. Burgi, E. Das chlorophyll als wachstumsstoff. *Klin. Wchnschr.* 9:789 (April 26 1930).
- 22 Gahan, E., Mine, P.R. and Finkle, T.H. Chlorophyll in the treatment of ulcers. *Arch. Dermatol. Syphilol.* 49: 849-851 (1943).
23. Goldberg, S.L. The use of water soluble chlorophyll in oral sepsis. *Am. J. Surg.* 62: 117-23 (1941).
24. Ichimura, S. General meeting of the Pharmaceutical Society of Japan, Hokuriku Branch, Toyama City, Japan, Oct 27, 1973.
25. Horikoshi, T., Nakajima, A. and Sakaguchi, T. Uptake of uranium by various cell fractions of chlorella regularis. *Radioisotopes* 28(8):485-487 (Aug. 1979).
26. Surrey and Morse. FDA petition for the importation of chlorella.
27. Dam, R., Lee, S., Fry, P.C. and Fox, H. Utilization of algae as a protein source for humans. 1. *Nutrition* 86:376-382 (1965).
28. Hunter, B. and Batham, P. Acute oral toxicity to rats of green chlorella 'and yellow chlorella powders Bulletin of Huntington Research Center, Huntington, England, Nov. 1972.
29. Rei, Bunso. *Health Revolution: Chlorella*. Kyoto: Nisshosha Co. Ltd., n.d.
30. Takechi, Yoshiro. *The Science of Chlorella*. Tokyo: Takechi Chlorella Research Center, n.d.
31. Takechi, Yoshiro. Medical effects of chlorella. *Gakushu KenkyuSha* (Tokyo), Nov. 30, 1971.

32. Oritoni, Takashi. *Fundamental Information of Chlorella*. Private publication; undated.