Chapter 3

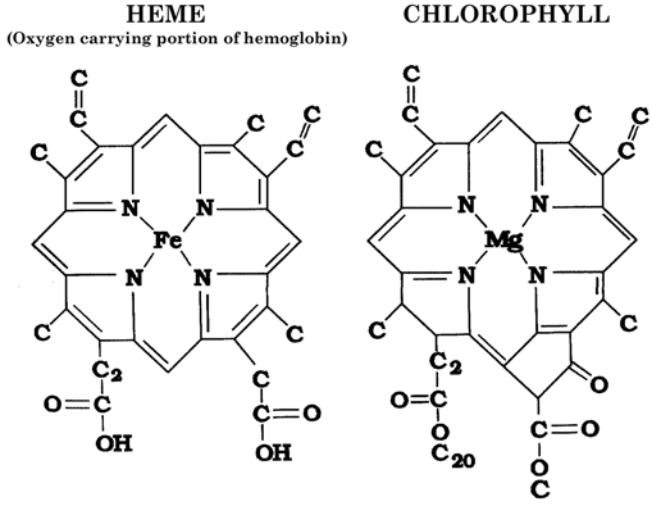
Chlorophyll and Blood Regeneration

Chlorophyll is the substance which makes green plants green. The chlorophyll molecule has the unique capacity to convert the energy of the sun into chemical energy (through photosynthesis), which the plant uses to make carbohydrates from carbon dioxide and water. Ultimately, all living things—plant and animal—derive their energy, and therefore their life, from solar energy through photosynthesis.

Yet, chlorophyll is not so unique in its chemical make-up. It is built around a structure known as a porphyrin ring, which occurs in a variety of natural organic molecules. The most interesting group of molecules which contain porphyrin rings are those involved in cellular respiration, or the transportation and consumption of oxygen. These include hemoglobin, myoglobin, and the cytochromes. Hemoglobin is the substance in human blood which carries oxygen from the lungs to the other tissues and cells of the body. The structures of chlorophyll and heme are shown in figure 3.1.

Obviously, the two structures are very similar. The most apparent

Figure 3.1 Chemical Structures of Heme and Chlorophyll



difference between them is that the porphyrin ring of hemoglobin is built around iron (Fe), while the porphyrin ring of chlorophyll is built around magnesium (Mg). The chemical similarity between hemoglobin and chlorophyll was first suggested by Verdel in 1855,[19] and specifically demonstrated in the early 1920s. In the twenty years that followed, a considerable amount of research was done to see if the two substances were interconvertible in the body. We discuss this research in the following section. We would first like to point out, however, that the claim that chlorophyll and hemoglobin are directly interchangeable is oversimplifying the relationship between these two complex molecules.

Can chlorophyll, so abundant in the world around us, supply the body with hemoglobin, a vital blood component? It's an attractive idea. Certainly, there is anecdotal and research evidence that chlorophyll-rich foods such as wheat grass help in some way to "build" the blood. After an exhaustive review of the scientific research relating chlorophyll to blood, we have concluded that the relationship between the two is much more complex, and indeed more beautiful, than the simple idea of the body's substituting an iron molecule for a magnesium molecule to make hemoglobin from chlorophyll.

The exchange of oxygen for carbon dioxide in the body takes place in the circulating red blood cells. These contain the red pigment heme, bound to a protein, globin, to make hemoglobin. The physiological processes involved in the synthesis, degradation and exchange of elements in red blood cells are complex, and actually not completely understood. But some parts of the process which relate to nutrition have been clearly delineated. Nutrients essential to the maintenance of healthy blood include iron, copper, calcium, and vitamins C, B-12, K, A, folic acid, and pyridoxine, among others.

Many of the components which build and sustain the essential elements in blood are also found in foods that are high in chlorophyll. A remarkable relationship exists between the complex process of respiration in animals and the equally complex but very different process of photosynthesis in plants. In ecological terms, we know that the two processes are interdependent and are essential to the sustenance of all life on Earth. The inhalation of oxygen/expiration of carbon dioxide by animals complements the "inhalation" of carbon dioxide/expiration of oxygen by plants. The revelation that many of the elements of plant "blood" resemble and are in some cases identical to those of animal blood is not surprising in this context.

The young cereal plant, dependent on its own rich supply of chlorophyll for the work of growth and development, absorbs and synthesizes the nutrients it requires—vitamin K, vitamin C, folic acid, pyridoxine, iron, calcium and protein. These nutrients are also vital to the generation and utilization of hemoglobin, the energy courier of animal blood. The similarities between chlorophyll and heme are not limited to appearance and function. Chemists[89] report that the synthesis of heme by animals can occur in much the same way as the synthesis of chlorophyll in plants.[5]

For many years the general public and some health practitioners have considered green vegetables to have value as "blood builders." This opinion was reinforced by the observation that animals which ate only leafy green plants had ample amounts of hemoglobin in their red blood cells.[105] As described in Chapter 2, the similarity between hemoglobin and chlorophyll was the impetus for Charles Schnabel's groundbreaking research on the cereal grasses. As early as 1926, research suggested a possible relationship between the chlorophyll component pheophytin and hemoglobin generation.[121] Other studies indicated that feeding chlorophyll-rich foods to rats stimulated the regeneration of red blood cells.[125] Researchers were able to demonstrate that this effect was not due to the iron or copper in the green foods.

Early work done in several laboratories suggested that the relationship between hemoglobin and chlorophyll was not only chemical, but biological as well. In 1934, Dr. Rothemund and his colleagues reported that the porphyrins from chlorophyll could stimulate the synthesis of red blood cells in a variety of animals, but only when fed in small doses.[119] Drs. Hughes and Latner fed several doses and forms of chlorophyll to anemic rabbits in 1936. Extremely small doses of purified chlorophyll or large doses of "a crude chlorophyll extract" produced "a very favorable effect on hemoglobin regeneration." They suggested that "the chlorophyll is acting as a physiological stimulant of the bone marrow and is not really concerned with the actual chemistry of regeneration of the porphyrin."[58] This means that components of chlorophyll found in foods or when fed in very small purified amounts may stimulate the synthesis of red blood cells in the bone marrow.

In 1936, Dr. Arthur Patek reported the results of an interesting study. Fifteen patients with iron-deficiency anemia were fed different amounts of chlorophyll along with iron. It was already known that iron alone cures this condition, but Patek found that when chlorophyll and iron were given together, the number of red blood cells and the level of blood hemoglobin

increased faster than with iron alone. No such results for this type of anemia were obtained with chlorophyll alone. As stated by Dr. Patek:

"This study may serve to encourage the use of a diet ample in greenstuffs and protein foods, for it must be that over a long space of time favorably nutritious elements are absorbed which aid the blood reserve and which furnish building stones for the heme pigments necessary to the formation of hemoglobin."[105]

Intact chlorophyll molecules are not well absorbed directly into the blood stream of most animals.[6,66] So the extremely small amounts of chlorophyll shown to stimulate hemoglobin generation are probably all that can be absorbed from green plants.

More recent research[54] indicates that some porphyrins (ringed structures in heme and chlorophyll) stimulate the synthesis of the protein portion of the hemoglobin molecule. Thus, portions of the chlorophyll molecule may enhance the body's production of globin. This may provide a partial explanation of the effect of chlorophyll on hemoglobin synthesis.

Chlorophyll and Blood Regeneration: A Summary

There are many reasons why cereal grass and other dark green plants can be considered "blood-building" foods. The vitamins and minerals in cereal grass are essential to the synthesis and function of the components of healthy blood. But perhaps the most interesting connection between green foods and blood is the similarity in the structures of the two colored pigments, heme and chlorophyll. The biological relationship between these two molecules, though studied for over 60 years, is still not completely clear. It does appear, however, that small amounts of the digestive products of chlorophyll may stimulate the synthesis of either heme or globin or both in animals and humans.