Chronic Fatigue

by Ray Peat, Ph.D.
Ray Peat's Newsletter

A good thing about science is that even dull-witted people can make real contributions to knowledge, by working carefully and methodically. Science tolerates (but doesn't require) quite a bit of stupidity. But I am inclined to think that education (or training) in science is heavily biased toward stupidity. It is through education that the achievements of science become part of our culture, and our culture influences the future directions science will take. So, both science and our culture would be better off if we would habitually ask whether the scientist's basic assumptions are justified, what alternative explanations had been considered, exactly what is meant by a specific word, and so on. Such questions almost always reveal the most embarrassing weaknesses in a position that "almost everyone agrees is correct." In biology and medicine, it seems that nearly everyone explains almost everything with a few interlocking ideas: DNA, membranes, membrane pumps, membrane receptors and receptors for the DNA, and ion channels. A belief in the explanatory power of these ideas can convert an observation that bacteria behave a little oddly when they are given ethyl alcohol, into a publishable speculation on the "molecular biology of membranes."

When the cells of fat, or depressed, or tired people are found to be in a low energy state, defective membranes, or membrane pumps or membrane receptors are often mentioned. Since phospholipids, which contain fatty acids of various degrees of unsaturation, are believed to be a major component of "the membranes," some people argue that eating more of the polyunsaturated fats will help to build new membranes, or to increase the "fluidity" of the membranes. If it is suggested that the cells should be producing more energy, some people suggest that, since the "mitochondrial membranes" are highly unsaturated, eating more of the polyunsaturated fats will help them to produce more energy.

A crucial enzyme in the mitochondrion is cytochrome oxidase, which reacts directly with oxygen, completing (or beginning) the process of chemical respiration. It is this enzyme (which is most sensitive to cyanide) which appears to be a "choke point" for energy production in various situations. Learning how to preserve and promote the activity of this enzyme is an important issue for everything having to do with biological energy.

Mitochondria from animals which are fed a diet lacking the "essential" unsaturated fatty acids are more resistant to oxidation than the mitochondria from animals fed a standard diet containing unsaturated oils, but they also have very different in vitro swelling behavior. R. M. Johnson's investigations (*Exp. Cell Res.* 32, 118-127, 1963) suggested that "the swelling tendency in liver mitochondria...is associated with altered respiratory and/or phosphorylating mechanisms rather than with membrane alteration." Kunkel and Williams (*J. Biol. Chem.*, 1951) found that the very high respiratory rate of animals fed a diet lacking polyunsaturated fats was caused primarily by a great increase in the activity of cytochrome oxidase, and that adding an "essential fatty acid" strong inhibited this enzyme's activity. (Other interesting observations were that "endogenous" respiration was low in the oil-deficient animals with a high metabolic rate, and aerobic glycolysis failed to produce energy, while anaerobic glycolysis was normal. Warburg emphasized the importance of aerobic glycolysis in cancer metabolism. Anaerobic glycolysis occurs in healthy cells. Aerobic glycolysis – the kind which is typical of cancer – being energetically idle in these animals might relate to the known freedom from cancer of animals which do not receive unsaturated fats.)

Cytochrome oxidase contains both iron and copper, and the copper component is apparently responsible for the enzyme's absorption of red light. The copper's function isn't understood, but it is suspected to be involved in regulating the efficiency of respiration. A protein called metallothionein, which is induced by cortisol or heavy metals, also binds copper, and might be one of the ways in which stress and heavy metal poisoning can accelerate the process of aging and degeneration.

The similarity of the effects of cyanide and polyunsaturated fats on respiration, and on cytochrome oxidase, suggests the possibility that the "essential" fatty acids might, like cyanide, form a complex with the copper ion. Unsaturated compounds, especially unsaturated phospholipids, can form strong chelation complexes with copper.

While thyroid supplementation produces increased activity of cytochrome oxidase, the avoidance of unsaturated oils would probably, to a great extent, make thyroid supplementation unnecessary to maintain a high rate of health-supporting mitochondrial respiration. Pregnenolone often normalizes metabolism in a way that can make thyroid supplementation unnecessary, and part of its action is probably the result of stabilizing the mitochondria. Even cholesterol (which is converted to pregnenolone in the mitochondria) seems to have a stabilizing effect, since it inhibits oxidation of unsaturated fats.

B.L. Epel (*Photophysiology* vol. VIII, 1973, pp. 209-230), discusses the evidence showing that blue light inhibits respiration by inactivating cytochrome oxidase, and says "If it is conceded that this phenomenon is universal, it is then intuitively obvious that most organisms must possess a protective or active repair mechanism since sunlight appears to be directly detrimental to few organisms."

The many studies which show that red light promotes respiration probably explain the fact that the blue light in sunlight isn't very harmful, since the sun also contains red light, which would tend to reverse the damage done by the blue light. Since red light penetrates much more deeply into animal tissues than does blue or ultraviolet radiation, larger animals would be more strongly affected by the beneficial fractions of sunlight – the internal tissues receive only red light.

The winter sickness and stress of darkness that I have talked about so much are metabolic disturbances resulting from inefficient respiration, and involve fatigue, hypoglycemia with sugar cravings, and hormone imbalances which lead to nutritional problems, such as vitamin A deficiency.

Although healthy respiration is many times more efficient than glycolysis in producing usable energy, the combined effects of getting adequate red light and using butter and coconut oil instead of unsaturated oils will cause a great increase in energy consumption. People with a significant amount of fat in their body, who have in the past eaten foods containing vegetable oils, are likely to draw unsaturated fats out of storage, with toxic effects unless vitamin E, thyroid, and coconut oil are used protectively until tissue stores of unsaturated fats are depleted. (Typically, body stores of fat take four years to completely reflect the change to a different type of dietary fat.)

Coconut oil is rich in lauric acid, which is being discussed lately as an anti-viral agent. Lauric acid inhibits glycolysis, so coconut oil will tend to prevent hypoglycemia, while providing non-glycolytic calories directly to the respiratory system.

Milk and shrimp can contribute to mitochondrial respiratory efficiency, since milk has a low iron content, and shrimp are very rich in copper. Iron is an important catalyst in the formation of free radicals, and copper is involved in protecting against iron, as well as in the function of cytochrome oxidase. (Even before Hartroft and Porta discussed, in 1967, the free-radical promoting activity of iron which forms "age-pigment," iron was known as a carcinogen or cancer promoter. (J. Balo and I. Banga, "Effect of metal complexes upon experimental carcinoma," *Acta Un. Int. Cancer*, 13, 463-5, 1957; A. Haddow and E.S. Horning, "On the carcinogenicity of an iron-dextran complex," *J. Nat. Cancer Inst.* 24, 109, 1960.)

Anemia can cause fatigue, and iron (like arsenic) tends to stimulate the formation of red blood cells, so many people advocate iron supplements for chronic fatigue. Although the immediate effect is to deliver more blood to the tissues, providing more energy, the long-range effects are not good, especially when iron is added to a diet containing significant amounts of the unsaturated fats. When anemia is caused by something other than iron deficiency (and it usually is), it is important to find the actual cause. Thyroid deficiency, estrogen excess, various vitamin deficiencies, protein deficiency, and various other mineral deficiencies should be considered.

Reference: *Journal of the National Cancer Institute* 24(109), 1960.

For Subscription to Ray Peat's Newsletter, write:
Ray Peat, Ph.D.
P.O. Box 5764
Eugene, OR 97405