Chapter 6

Microbial Factors and Nutrition in Carcinogenesis

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1. Introduction: Environmental Factors and Cancer

Environmental influences are held responsible for more than 80% of human cancers (Peery, 1975; Davis, 1975). A large number of factors have been incriminated including industrial chemicals and pollutants, food additives, fungal products, tobacco smoking, naturally occurring plant products, and deficiencies or excesses of diet. The notion that environmental factors are the major determinants in the etiology of human cancers is based on the uneven geographical distribution of the disease (Drasar and Irving, 1973; Armstrong and Doll, 1975). Armstrong and Doll (1975) have studied incidence rates for 27 cancers in 23 countries and mortality rates for 14 cancers in 32 countries. Stomach cancer is high in Japan, South America, and Eastern Europe, and low in North America and Western Europe. An exactly inverse geographical distribution is noted for cancers of the colon, breast, corpus uteri, ovary, and kidney.

Studies of migrant populations indicate that their cancer incidence approximates the prevailing rates in the place of residence rather than the place of birth (Smith, 1956; Haenszel and Kurihara, 1968; Staszewski and Haenszel, 1965; Haenszel et al. 1973). Dunn (1975) has compared the incidence of stomach cancer in Japan with that among Japanese in California. The occurrence of this tumor undergoes a stepwise reduction from high rates in Japan to intermediate rates in immigrant Japanese to lower rates in American-born Japanese. On the
other hand, cancers of the colon, breast, uterine cavity, ovary, and prostate show the opposite trends, and among American-born Japanese the incidence of these tumors are approaching those observed in native Caucasians.

Armstrong and Doll (1975), Howell (1975), and Drasar and Irving (1973) have correlated cancer incidence and mortality with a wide range of dietary factors. Stomach cancer is inversely related to total fat and protein consumption, whereas cancers of the colon, breast, corpus uteri, and kidney are positively correlated with these constituents. Colon cancer incidence is inversely related to consumption of cereals, but is not correlated with other fiber sources such as potatoes, vegetables, fruits, nuts, and seeds.

While these studies do not provide definitive evidence for a particular food category, they do suggest strongly that diet plays a major role in the etiology of cancer.

1.1. Dietary Mechanisms in Cancer Induction

There have been many hypotheses to explain the effects of diet on development of neoplasms. It has been suggested that carcinogens or procarcinogens may exist in food products. The cited examples are nitrosamines and nitrosamides (Issenberg, 1976), food dyes (Berg, 1976), cycasin (Laqueur et al., 1963), tryptophan (Dunning et al., 1950), pyrrolizidine alkaloides, and safrole (Miller and Miller, 1976). Various fungi which are found in food may contaminate it with toxic and carcinogenic products such as aflatoxins, sterigmatocystin, yellow rice toxins, and griesoflurin (Miller and Miller, 1976). Bacterial products in food are another source of potential carcinogens. These compounds include actinomycin D, mitomycin C—both of which induce sarcoma (Miller and Miller, 1976)—and streptozotocin, which causes tumors of the renal cortex. Substances which inhibit tumor development are also known to exist in our diet. Antioxidants such as butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), and ethoxyquin inhibit chemical carcinogenesis (Wattenberg, 1974).

2. Intestinal Microflora

It is currently recognized that many classic carcinogens are really procarcinogens and are dependent on some metabolic activating system to cause their harmful effects. The liver and other host tissues are usually implicated in this regard. However, in the case of colon cancer, and perhaps breast cancer, as will be discussed below, the metabolic changes may be mediated by the tremendous “fermentation pot” that encompasses our large bowel and its luxuriant microflora.