EXPERIMENTAL CONTRIBUTIONS TO THE PROBLEM OF IMPROVING THE NUTRITIONAL QUALITY OF FOOD PLANTS

WERNER SCHUPHAN

(Geisenheim/Rh.)

ABSTRACT

Spheres of activity to improve nutritional quality in food plants are manifold. They may be seen in the field of genetics and ecology and in man’s influence particularly in different cultural practices in Agriculture such as application of pesticides and fertilizers.

Genetics

‘EEC-Standards of Quality’ are mainly designed to facilitate trade and marketing across the borders. They are based on visual characters (size, colour, appearance, freedom of blemishes etc.) which necessitates expenditures in agricultural and horticultural management (fertilizing, application of pesticides). In consequence the consumer pays for somewhat ‘cosmetic like’ quality and more and more asks for this to be replaced by a ‘quality’ which reflects the nutritional value of the plant food.

There are cultivars and strains of many fruits and vegetables which have great potential for developing resistance to plant pests, good market quality, good taste and outstanding nutritional quality. Of particular importance are vitamins, sugars, acids and a favourable relation of both, essential oils etc. 130 cultivars of apples differed in contents of vitamin C by as much as 933%, the contents in carotene varied in German carrots about 225% according to our investigations.

Ecology

Environmental factors such as climate and soil give rise to considerable variation in the nutritional value within the limits set by the genetical constitution of cultivars. Various examples may underline the influence, mainly of light and temperature, on the contents of sugars, acids, carotene, vitamin C, dry matter and essential oils.

Man’s influence

The use of pesticides — although necessary for plant protection — is often overdone, e.g. by overapplication of biocidal sprays.

Pesticides may eventually become hazardous to health by accumulation of toxic residues of the pesticides or of their metabolites. The latter are sometimes more toxic than the pesticide itself. Pesticide use can also produce undesirable alterations in those plant constituents which are important to health e.g. they can cause significant depressions in levels of ascorbic acid (spinach) and carotene (carrots).

Heavy N-application to crops e.g. to spinach, which is considered to be an infant food ‘par excellence’, may be hazardous to health when high contents of N-borne or 2,4-D induced Nitrates are reduced to toxic Nitrite. This can cause methemoglobinemia and circulation troubles in infants.

In addition overapplication of N may lead to undesired side effects such as reduced shelf life in potatoes, carrots, cabbages etc., decreased levels of vitamin C, sugars and some minerals important to health (K, Ca, P, Fe).

Examples are given which suggest that an additional supply of NPK to a normally fermented good stable (farmyard) manure was beneficial to vegetable crops resulting in higher contents of vitamins, minerals and trace elements compared with those grown with unsupplemented stable manure. These products proved superior in nutritional value as reflected by higher gains in weight of infants, a better teething performance, higher contents of vitamin C and carotene in the blood and a far better blood picture (number of erythrocytes, amounts of serum iron and contents of haemoglobin).

Plant foods play a significant role in human nutrition. In large parts of the world food plants form the basis of more or less pure vegetarian diets. This has been true for many centuries.

From a nutritional point of view these diets give rise to problems unless plant food high in biological value of protein and containing sufficient amounts of vitamin B$_{12}$ is regularly provided. Food plants having a protein of high biological value are potatoes, green leafy vegetables, certain pulses (soy beans) — or as a mixture — phaseolus beans + maize (1). Vitamin B$_{12}$ can be supplied by fermented food such as different soy bean meals.

According to D. Cuthbertson (2) consumption of pure vegetarian diets is due to ignorance, taboos or religious or cultural prohibitions. On the other hand there are populations living on diets considered nearvegetarian because of economic necessity and availability of little or no animal products (3). Lack of animal products and the need to produce high-yielding food plants were typical of the food situation during and after World War II.

Recognized scientists in medicine and nutrition (cit. (4)) claimed that plant food — prevailing during and immediately after World War II — was responsible for the relatively good state of public health in Germany and Switzerland. They emphasised the beneficial effect of high contents of crude fibre in plant diets and the lower incidence of Diseases of Western Civilization.

Nowadays, plant foods attract considerably more attention in nutritional science particularly since competent research in developed countries has elucidated the exceptional role of these plants and their chemical constituents in preventing — or at least in reducing the prevalence of diseases of Western civilization (5, 6, 7, 8).

This may be demonstrated by the aid of the scheme shown in Figure 1. The lower part of this compiles special chemical plant constituents which have — besides vitamin C, carotene, and essential oils having antimicrobial effects — a positive influence in fighting diseases of civilization: High contents of Mg and K, crude fibre, flavonoids, a favourable ratio of K/Na = 1, low contents of fat and protein. According to H. J. Holtmeier (9)