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Dietary vegetables and environmental health

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INTRODUCTION

In 1941 Kensler, et al observed that the B-vitamin riboflavin protected rats against the potent hepatocar-cinogen aminoazo dyes (1). Ten years later Mueller and Miller showed that this vitamin enzymatically cleaved these dyes to noncarcinogenic metabolites in the liver (2). Further studies in the laboratory of Miller showed enhanced hepatic metabolism of these dyes when rats were fed a practical ingredient type of diet as compared to a more purified diet composed of casein, sugar, corn oil, cellulose, vitamins, and minerals (3).

These pioneering studies on the influence of nutritional and dietary factors and the metabolism of dyes revealed that changes in diets can have dramatic effects on the metabolism and action of foreign chemicals. Extension of these studies by many investigators have shown that changes in specific foods, as well as specific nutrients, can have an effect on multifunctional tissue enzymes collectively known as microsomal mono-oxygenases, or mixed-function oxidases (MFO) (4,5,6). These enzymes are induced by many foreign chemicals including drugs, environmental carcinogens etc. Induction of these enzymes indicate that increased metabolism of exogenous chemicals are occurring. However, this increased metabolism could mean either the chemicals are being detoxified for rapid excretion, or being metabolized to more potent metabolites known as the "ultimate carcinogen" (7).

A number of common vegetables in the botanical family *Cruciferae,* e.g. cabbage, brussels sprouts, cauliflower, kale, etc. have been observed to stimulate increased MFO activity in the intestines of experimental animals (8,9). Work in our laboratory (10) showed that this increased activity also occurred in the liver of rodents. This report is a brief overview of some recent investigation of ours (11) showing that experimental diets containing cauliflower reduces the hepatic toxicities of two chemically dissimilar food contaminants, i.e. the flame retardant, polybrominated biphenyls (PBB's) and aflatoxin B1 (AFB1). PBB's have contaminated meat and milk, especially in Michigan, and AFBi is a potent carcinogenic metabolite of the mold *Aspergillus flavus* observed growing in peanuts, grains, and other foods stored under relatively high moisture conditions.

RESULTS

PBB is not an acutely toxic chemical. However, feeding rats diets containing 50 ppm of PBB's for 3 weeks produced fatty livers, as well as increased residues of the compound in this organ. Male rats fed diets containing 25 per cent freeze-dried cauliflower exhibited markedly reduced levels of liver fat, as well as residual liver PBB depression of approximately 50 per cent.

Fischer rats fed 2 ppm AFB1 for 26 weeks exhibited 100 per cent mortality with large hepatocarcinomas by the end of 41 weeks when consuming a purified diet. Animals fed this level of AFB1, combined with a 25 per cent cauliflower diet all survived. However, these animals did show lowered body weights and small grade I and grade II adenomas.

In-vitro experiments on the tissues of cauliflower fed rats indicated that MFO activity was moderately activated with increased enzyme-substrate reaction rates in the liver as well as in the intestine and kidney.

CONCLUSIONS

These data indicate that dietary cauliflower inhibited the toxic responses, including carcinogenicity, of two dissimilar chemical contaminants. Various sulfur containing compounds, known as glucosinolates, are naturally present in relatively high quantities in *Cruciferae* vegetables. Metabolite products of glucosinolates, indoles, have been attributed to inducing MFO activity in animals (12). Investigations in our laboratory have shown that indoles can stimulate liver MFO activity, but apparently only at exceedingly high dietary levels (13). Recent 10-year epidemiological studies with over 120,000 Japanese men showed a significantly lowered death rate due to prostrate cancer in men consuming "green-yellow vegetables" as compared with men rarely consuming these vegetables (14).

The mechanisms for this cancer inhibitory effect of dietary vegetables appears to be involved with tissue MFO induction. However, naturally-occurring vitamins, fiber, minerals, or non-nutrients may be directly, or indirectly responsible for this effect. It appears crucial to know if other common dietary vegetables besides *Cruciferae* exert similar effects.

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