

Letter to the Editors

Are the effects of dietary fruits and vegetables on human health related to those of chronic dietary restriction on animal longevity and disease?

Doll & Peto (1981) reported that epidemiological studies in man indicated a close association between diet and tumour incidence and suggested that changes in the diet could greatly reduce the incidence of cancer. A decade later Doll (1992), in a landmark review, suggested that some 30–60 % of tumours could be avoided by changes in lifestyle, particularly by increasing consumption of fruits and vegetables.

Many more epidemiological investigations have confirmed and extended the inverse association between cancer incidence and fruit and vegetable consumption. This work, reviewed by the World Cancer Research Fund (1997), demonstrates this relationship for a range of tumour types whether spontaneous or induced by carcinogens such as ethanol and tobacco. In response, national and international authorities, e.g. the World Cancer Research Fund (1997) and the Department of Health (1998), have promoted recommendations for increased fruit and vegetable consumption.

A depression of tumour incidence might be anticipated to lead to an increased human lifespan, but this has not been emphasized as a potential advantage of increased fruit and vegetable consumption. Records of diet and life expectancy (Trichopoulos & Vasilopoulou, 2000), however, suggest an association between human longevity and consumption of a traditional Mediterranean diet, i.e. one rich in fruits and vegetables.

Intervention studies are essential to validate conclusions from epidemiological studies. Controlled investigations of changes in fruit and vegetable consumption on health in man would be exceedingly difficult (Mathers, 2000). Trials with human subjects have been carried out on substances, notably antioxidants, found in fruits and vegetables and anticipated to modify oxidative stress and thereby reduce cancer incidence. These tests have been negative or inconclusive (Mathers, 2000; Kaur & Kapoor, 2001).

Numerous reports show that dietary restriction can lead to major increases in the lifespan of many animals, notably an eel worm, *Caenorhabditis elegans*, an insect, *Drosophila melanogaster*, and the vertebrates mouse and rat. Not only are there increases in lifespan, but in the mouse and the rat there are major decreases in the incidence of tumours whether spontaneous or induced by mutagens or transplants. These findings, reviewed by Weindruch & Walford (1987), continue to be confirmed and extended, while lifespan in *Drosophila* has been associated with genetic change (Clancy *et al.* 2001; Tatar *et al.* 2001).

The benefits (decreases in tumour incidence) apparently associated with fruit and vegetable consumption in man

resemble the phenomena (reduction in neoplasms and extension of lifespan) observed after dietary restriction in animals.

Joseph *et al.* (1999) report that supplementation of the diet of rats with fruits or vegetables (blueberry, strawberry or spinach or their aqueous extracts) prevented or reversed age-related changes in neuronal and behavioural function. These findings suggest a relation between the mechanisms by which health may be modified by dietary restriction in animals and consumption of fruits and vegetables by man.

Further research is required to confirm the observations of Joseph *et al.* (1999), which may offer novel means of identifying factors in fruits and vegetables concerned with ageing, and perhaps even the control of carcinogenesis. One may speculate that tests derived from such laboratory animal studies could permit investigation of the ways in which dietary fruits and vegetables modify the ageing process (and perhaps carcinogenesis). Though using rapid modern techniques such research might recall the investigations which revealed the identity and metabolic roles of the major nutrients during the first half of the last century.

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