

## Conference Report

# 2001—Beyond the Balanced Diet<sup>☆</sup>

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This year's Nutrition Society Annual Conference was a celebration of progress in nutrition research over the past 50 years. The programme was wide ranging and, true to the theme of the meeting, sessions clearly demonstrated that we are now way beyond the balanced diet. How does diet modulate disease risk and can nutritional status affect the ageing process? These were just two of the hot topics nutritionists discussed and debated. Many of the issues are pertinent to those working in food science and technology, especially against a backdrop of growing consumer interest in the 'added benefits' of foods. This report will focus mainly on developments in micronutrient research.

### **Zinc, copper and skeletal health**

Osteoporosis is almost universal in very old age and is a major cause of morbidity and mortality in elderly people of both sexes. The cause of this debilitating disease is multifactorial and includes genetic predisposition, nutritional and endocrine changes, habitual exercise levels and body weight. Although the role of calcium in this condition has been much studied, less interest has been afforded to other minerals such as copper and zinc. Nicola Lowe, from the University of Central Lancashire, UK, explained how copper and zinc might provide a therapeutic effect in osteoporosis.

Zinc and copper are both essential cofactors for enzymes involved in the synthesis of various bone matrix compounds. Zinc stimulates bone formation and

mineralization and has a structural role, bound to fluoride in the hydroxyapatite. Copper is important for osteoblast activity and decreases the level of free radicals in bone. There is evidence that both dietary intakes and absorption of these two important minerals is poor in the elderly population.

A study that examined the effects of various micronutrient supplements on the rate of bone loss in osteoporotic women was reported. Compared to placebo, calcium alone resulted in a slowing of bone loss, but a supplement containing calcium, zinc, copper and manganese actually increased bone mineral density in the osteoporotic women studied. Calcium can interfere with the absorption of zinc and copper, especially at high levels. Iron also competes with copper and zinc for absorption. Thus, a careful dosing strategy is needed for optimum effectiveness. As it is difficult to get elderly people to change their eating habits, and because of their decreased appetite, fortification of foods such as milk or soup was suggested as a way forward.

### **Selenium intake**

Selenium is the only trace element found in the genetic code. It has an antioxidant role, is the powerhouse in sperm mitochondria and the catalyst for production of active thyroid hormone. While selenium deficiency diseases have been recognized for some time, Margaret Rayman, from the University of Surrey, UK, argues that evidence is mounting that less overt selenium deficiency can also have an adverse effect on health.

Plants absorb selenium from the soil so the availability of selenium depends on geography. There is evidence that selenium intakes are diminishing in many European countries. For example, in the UK during the 1970s and 1980s, average intakes were around 60 µg/day. By the 1990s, intakes had dropped by half to about 30 µg/day (the UK recommended nutrient intake is 75 and 60 µg/day for men and women, respectively). Plasma selenium levels in Europe currently fall in the 'low' category. This drop in intake is largely because Europe has ceased importing American wheat and relies on homegrown wheat, which contains less selenium. Against this backdrop of sub-optimal levels of selenium, what are the implications for health?

Selenium deficiency leads to decreased immunocompetence and viral infections become more serious. For example, in a selenium-compromised host, the

<sup>☆</sup> Nutrition Society Diamond Jubilee Summer Meeting held at Sheffield University, 10–12 July 2001.

harmless coxsackie virus becomes virulent causing heart damage, and HIV infection progresses more rapidly to AIDS. A study providing selenium supplementation of 200 µg/day for 8 weeks was found to enhance the immune response.

Low levels of selenium may lead to impairment of antioxidant defences. This has implications for heart disease, and other conditions involving oxidative stress and inflammation, like rheumatoid arthritis. In reproduction, it has been found that plasma selenium levels are significantly lower in women who miscarry in the first trimester. There is also evidence that a higher selenium intake is associated with a reduced risk of cancer.

Studies underway or planned will help determine whether strategies to increase population selenium intake should be implemented. Public health measures might involve: adding sodium selenate to fertilizers, food fortification and enriching animal diets with selenium. Until then, people wishing to boost their selenium intake will have to eat foods naturally rich in selenium like Brazil nuts, offal, crab and fish, or perhaps try some functional foods which have added selenium. If supplements are taken, about 1000 µg/day is considered safe (6 mg/day is toxic).

### UV-induced skin damage

In the short-term, over exposure of the skin to ultraviolet radiation can result in sunburn, whilst chronic overexposure increases the risk of skin cancer and premature ageing. Malcolm Jackson, from the Department of Medicine, University of Liverpool UK, presented data examining how antioxidant micronutrients and omega-3 fatty acids might reduce tissue damage and increase resistance of skin during exposure to UV light.

UV light initiates the local inflammatory responses in skin and can cause tissue damage mediated by free radical species. The omega-3 fatty acids studied were eicosapentaenoic (EPA) and docosahexaenoic acid (DHA). These fatty acids were provided to subjects in a fish oil supplement, and 10 g of fish oil per day, containing 18% EPA and 12% DHA, for 3 or 6 months was found to reduce UVB-erythema sensitivity and quelled the inflammatory response in a variety of skin cell types.

The antioxidant nutrients studied were Vitamins C and E and β-carotene. As antioxidants they would be expected to reduce the level of free radicals in the skin and reduce oxidative stress. However, although serum levels of these nutrients were increased during supplementation, no beneficial effects were found on the erythema. So, rather than antioxidant vitamins, omega-3 fatty acids could be a route to skin protection from the inside.

### Alzheimer's disease

Thus, whilst antioxidant nutrients may not be particularly helpful against skin damage, they have many

other benefits within the body. Michael Grundman, from The University of California, USA, examined the potential impact of such nutrients in delaying the onset and progression of Alzheimer's disease (AD).

Oxidative stress is present in the brains of patients with AD within every class of biomolecule, including nucleic acids, proteins and lipids. This may be caused by mitochondrial abnormalities, inadequate energy supply or altered antioxidant defences. Oxidative damage in the brain may cause inflammation and be responsible for neuronal loss and the associated cognitive and functional decline observed in AD. Treatment with antioxidants is a promising approach for slowing the underlying rate of AD progression.

Five studies have so far shown that Vitamin E is lower in the plasma but not the brains of patients with AD. In clinical trials, a diet rich in Vitamin E has been found to delay reaching clinical endpoints such as deterioration in daily living functions or dementia. A 3-year study is underway with memory impaired people to determine if supplementation with Vitamin E delays the onset of AD. Other nutrients that need further investigation in relation to AD are Vitamin C, Vitamin A, selenium, zinc and copper. The clinical value of other substances such as coenzyme Q lipoic acid, creatine, melatonin, along with herbal remedies including ginkgo biloba and ginseng, still need to be determined with properly designed human studies. It is possible that combinations of antioxidants will provide greater benefits for AD sufferers, especially if they work in different cellular components or have complementary activity.

Fixed risk factors for AD include: advanced age, family history and being female. Environmental risk factors include: head injury, a sedentary lifestyle, a high fat diet, high cholesterol levels in mid-life and a low intake of antioxidant nutrients. So, with regards to the prevention of AD, current advice is to follow a low fat, cholesterol-lowering diet with plenty of fruit and vegetables. Plenty of exercise and maintaining intellectual activity is also important and, if possible, the avoidance of head injury!

### Antioxidants and ageing

Free radicals and oxidative stress have also been recognized as important contributing factors to ageing and many age-associated degenerative diseases. The modulation of oxidative stress by calorie restriction in animal models has been shown as one of the mechanisms that slow ageing and the decline of the body.

Mohsen Meydani, of the 3M USDA-Human Nutrition Research Center on Ageing at Tufts University, Boston, USA, discussed dietary components with oxidative capacity that have the potential for improving bodily functions and reducing degenerative disease. Once again, Vitamin E was highlighted. A study where elderly people were supplemented with Vitamin E

demonstrated an improved immune response and an increased resistance to oxidative injury associated with exercise. Other recent studies carried out by the Tufts University team have shown that polyphenols and Vitamin E may assist in preventing cardiovascular disease, in part through reducing the susceptibility of low density lipoprotein to oxidation and decreasing the expression of adhesion molecules. Some recent studies on the mechanisms by which antioxidants may prevent cancer were also discussed. Possibilities include: the inhibition of microvascular endothelial cells angiogenesis via suppression of interleukin-8 production and modulation of cell junction molecule, VE-cadherin.

### **Early diet and ageing**

Interestingly, whilst calorie restriction may be a strategy for longevity for adults, Aihie Sayer, from Southampton University, UK, presented data that suggest that energy restriction in early life has the reverse effect.

There is now good evidence that nutrition during the prenatal period is linked to age-related disease experience. Poor foetal growth leads to low-birth weight, which in turn has been associated with an increased likelihood of overweight, hypertension, glucose intolerance and osteoporosis in adult life.

Research is now looking at how growth and nutrition during the pre-weaning period affects certain structural and functional markers of the ageing process. For example over 8000 subjects in the Herefordshire ageing

study who were born between 1920 and 1930 have been followed up and assessed for lens opacity, hearing threshold and grip strength. Analyses were then carried out to determine if there was any correlation between early growth in these subjects and measures of ageing. It was found that those who grew least well during the first year of life were the most likely to have cataracts. Similarly, hearing threshold worsened with decreasing weight at age 1 year and grip strength was least in those with the lowest birth weights.

Animal intervention and human observational studies both suggest that early dietary restriction has a detrimental effect on adult health and is associated with ageing processes in bone, skin, ear, eyes and muscle. The underlying mechanisms of this phenomenon are still being elucidated and will increase understanding of the ageing process.

### **Cradle to grave**

It is becoming increasingly clear that the food we eat has a profound impact on our health from the cradle to the grave. Pre-natal and early nutrition is now recognised as an important influence over health and disease risk in adulthood, and diet in middle age has been linked to the development of age-related diseases like Alzheimer's disease. The whole process of disease development and ageing is linked and interrelated. Nutrition research will continue to unravel how nutrition can help optimize health and vitality.