

eat to your heart's content

Andrew Ramsey suggests adding a guilt-free sip of red to your bran, broccoli and beans.

Foods with the potential to improve human health by slowing the growth of degenerative illnesses such as cardiovascular disease, cancer, hypertension, diabetes and osteoporosis are receiving increasing attention from food and pharmaceutical industries, consumers and scientists.

The estimated annual cost of diet-related disease in Australia is \$3.2 billion. Research aimed at reducing this figure is taking place at CSIRO's Division of Human Nutrition in Adelaide. Chief of the division, Professor Richard Head, says foods with health potential, or 'functional' foods, could play a critical role in the fight against cancer and cardiovascular disease (which kill up to 80 000 Australians annually). They also may offer Australia economic opportunities through expanded food exports.

Head says that during the next 25 years, a range of food products will be designed to provide a physiological or medical benefit by regulating body functions. 'On the surface they will look like traditional foods, but in reality they will be specially chosen to modify and achieve particular health benefits,' he says.

The simplest kind of functional foods are those which are already present in our diet, but could be improved by selecting the healthiest cultivars (see graph on page 11). Another category is processed foods which have been specially modified, perhaps to contain less fat (such as low-fat milk) or enriched levels of antioxidants. Other examples are food ingredients such as modified starches and probiotic organisms

which are specifically incorporated into everyday foods such as bread and yoghurt respectively.

Research by the division has identified three classes of functional foods with specific health benefits. These are:

- dietary fibre (including resistant starch) which is important in regulating gastrointestinal health and offering protection from diseases such as bowel cancer;
- antioxidants, which are being studied for their role in preventing unwanted oxidation processes present in the early stages of diseases such as cardiovascular disease, cancer and possibly other degenerative diseases associated with aging; and
- fatty acids contained in oils from plants and fish which are believed to protect blood vessels from the effects of cholesterol, to help lower blood pressure and protect the cardiovascular system.

Why fibre is fab

Scientific evidence continues to support a link between diets rich in dietary fibre and decreased risk of cardiovascular disease (which accounts for 44% of all deaths in Australia every year), diabetes and a number of cancers.

Work headed by Dr Peter Baghurst from the division's Consumer Science Program indicates there are several possible ways in which dietary fibre can lower serum

cholesterol which, in turn, could contribute to decreased rates of coronary heart disease. (Fruits, vegetables and cereal grains are all good sources of dietary fibre.)

Baghurst and his team have found that some fibres may chemically bind bile acids, (which are synthesised from cholesterol), or that others may simply entrap the bile acids in the small intestine which prevents their

Functional foods could play a critical role in the fight against cancer and cardiovascular disease



reabsorption. As a result, in order to maintain the level of the body's bile pool, more cholesterol is diverted for the purpose of synthesising the bile acid.

There is also a possibility that the binding of bile acids in the small intestine might disrupt the micellar structures which are needed to absorb fat and cholesterol. Another theory, although one which the team believes may have a less significant impact, is that the volatile fatty acids

produced when fibre ferments in the large bowel can suppress the biosynthesis of cholesterol in the liver.

Despite some uncertainty concerning the precise value of cereal grain with respect to protection against colon cancer, the link between increased intake of fruit and vegetables and the protection they provide against colon cancer continues to strengthen.

Among the reasons cited for the beneficial role of fruit and vegetables in this area are that dietary fibre decreases the body's production of secondary bile acids which have been found to be co-carcinogenic in tests conducted on rodents. This gain can be offset, however, if the diet also contains a high level of fat.

High fibre levels are believed to reduce the body's exposure to carcinogens by increasing stool bulk and/or decreasing the time taken for digested foodstuffs to travel through the intestinal tract. In addition, fibre is understood to play an important role in binding carcinogenic compounds within the gut. It can lower the colonic pH level (with high levels believed to promote colorectal cancer) and aid in the production of butyric acid which may inhibit the growth and spread of tumour cells.

The research has also established possible relationships between dietary fibre and the effect of diabetes because high-fibre foods are typically absorbed more slowly and remain in the digestive system longer. Thus they could be used to reduce insulin requirements and lower the risk of cardiovascular disease among diabetics. High-fibre diets are also believed to have





benefits in the treatment of constipation associated with other gastrointestinal diseases such as irritable bowel syndrome, diverticular disease and haemorrhoids.

Some of the research's most promising results involve health benefits obtained from the consumption of phytoestrogens. These are substances found in edible plants and plant products which have a similar structure and function to steroid hormones found in mammals and, as a result, have the ability to influence the body's hormone-dependent processes.

'Interest in these substances has escalated over the past decade due largely to speculation that consumption of foods rich

and vegetables (the highest known concentrations are found in flaxseed or linseed).

Initial evidence showed that the incidence of breast and prostate cancer was lowest in countries where soy products were an integral part of the diet (mainly Asian countries). Further studies, including one conducted among 900 women over four years by the division in Adelaide, found reduced risks of breast cancer among women whose diets included a high intake of dietary fibre which inevitably included high levels of phytoestrogens.

Dietary fibre is thought to provide a level of protection against hormone-dependent cancers by reducing the levels of oestrogen circulating in the body. A daily intake of about 30 grams of dietary fibre (bran breakfast cereals, wholegrain cereals and breads, dried peas and beans, and dried and fresh fruit and vegetables) can offer some protection against the development of breast cancer which kills about 2200 Australian women annually.

Capturing free radicals

Also under scrutiny for their role in reducing the risk of cancer and heart disease are substances known as polyphenols which act as powerful antioxidants. These are found

naturally in a number of foods including tea, wine, grapes, soybeans, cereals, cruciferous vegetables (such as cauliflower and broccoli), apples, citrus fruit and onions.

According to the division's Dr Ian Record, polyphenols range in structure from the relatively simple substances found in soybeans and green tea, through to complex substances obtained from grapes

and wine. Their value to plants is that they have the ability to absorb potentially dangerous entities known as free radicals which are produced through exposure to ultraviolet light.

The human body also produces free radicals: small, short-lived molecules which are highly reactive. While some serve a valuable function, others are derived from oxygen which can damage cell membranes, proteins and genes and are blamed for initiating many aspects of heart disease and causing genetic damage which can lead to cancer. The potential now exists to identify particular plants that have these special agents which can act in concert with our own antioxidant systems to reduce the impact of free radical damage and so lower the risk of degenerative disease.

Of particular interest to Record are the beneficial effects offered by green and black tea, and by red wine which is believed to play a key role in the so-called 'French paradox' in which French people with a high-fat diet do not show an expected corresponding high level of heart disease.

Record says acceptance among the scientific community of the 'French paradox' had only occurred recently, but even though there was still much to learn about antioxidants and their impact on unwanted oxidation processes in the early stages of some diseases, the evidence in favour of polyphenols is slowly mounting.

He says a greater understanding of the bioavailability, metabolism and distribution of polyphenols in humans is crucial to ascertaining the potential for health benefits, and the imminent release of results from two recent studies undertaken by the division will help that process.

'At present, although considerable interest is being shown in the potential health benefits of wine and tea, in reality little is known about how the active agents are absorbed by the gut and then what



Of particular interest are the beneficial effects offered by green and black tea, and by red wine

in phytoestrogens may confer protection from the hormone dependent cancers such as breast cancer in women and prostate cancer in men,' Baghurst says.

The most important phytoestrogens are the isoflavonoid compounds found readily in legumes (soybeans and their products are the richest known source) and the lignins which are present in whole grains, legumes

happens to them in the body,' Record says. 'That's the sort of thing we have to try to understand so we can make some sort of predictions as to which antioxidants are most beneficial.'

Fishing for fatty acids

The division is an acknowledged world leader in its work on fatty acids, in particular showing that fish oil can protect against heart disease. It has shown that antioxidants such as plant flavonoids and vitamin E, along with dietary n-3 fatty acids, are effective in correcting impaired blood vessel function in animals suffering from hypertension.

Dr Peter Clifton says the division is evaluating fatty acids derived from algal plants rather than fish. Regular consumption of fish oil by animals has been shown to offer protection against serious heart rhythm disorders which are responsible for sudden death from cardiac arrest.

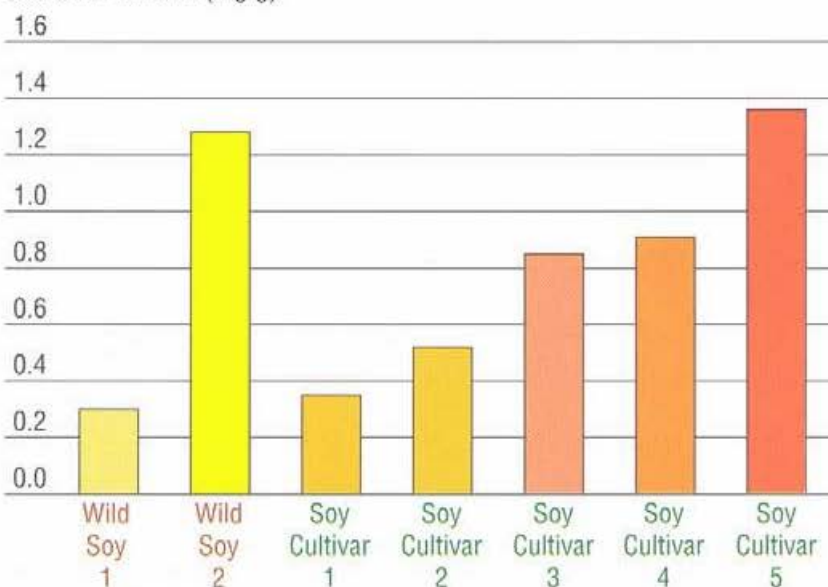
Clifton says despite the potential shown by fish oil in tackling heart disease, it has yet to achieve widespread acceptance because the cost of running exhaustive trials is prohibitively high and the prospect of ingesting up to 10 capsules of fish oil daily acts as a deterrent for many people.

'I think fish oil has a place,' Clifton says. 'Certainly, populations in places such as Japan where a lot of fish is eaten have a lower incidence of coronary disease and some controlled studies suggest there are cardiovascular benefits in eating fish regularly. However, there is not much direct evidence in humans which shows fish oil *per se* protect you.'

As a result of laboratory studies of fish oils, the division is continuing its work with canola oil which has shown the potential to provide some similar benefits if incorporated into the diet. Canola oil contains a short chain omega-3 fatty acid which can be converted to the forms of omega-3 fatty acids (EPA and DHA) which are the key components of fish oil.

Genistein Content of Soy Cultivars

Genistein Content (mg/g)



The simplest functional foods are those which already exist our diet, but could be improved by selecting the healthiest cultivars. This graph shows the varying levels of genistein in a range of soy cultivars. Genistein belongs to a group of substances called 'isoflavones' which have potential health benefits.

In animal studies these oils have been shown to be effective in stopping arrhythmias, the irregular heart rhythm which disrupts or cancels the electrical impulses which cause all cells in the heart to beat as one. And in animals predisposed to hypertension, the fatty acid contained in fish oil prevented the development of high blood pressure and abolished unwanted contraction of blood vessels.

On a less formal basis, the division has been introducing functional foods to humans too. Earlier this year (1996), CSIRO held a 'Live-to-100 Luncheon' in the Mural Hall of Federal Parliament House in Canberra as part of a program to raise national awareness of developments in the nutritional field.

Luncheon guests were treated to a menu featuring ocean trout flavoured with lime and ginger, medallions of beef, loin of lamb, supreme of chicken with a macadamia nut crust and tropical fruit meringue with Asian tropical fruits and mango sorbet. The dishes offered protection against illnesses such as cancer, osteoporosis, heart disease, anaemia, gut disease or aging. They also proved that healthy foods need not be dull and unpalatable. With freshly-brewed tea and red wine to complement the meal, the message was well received.

More information about functional foods is available on the division's World Wide Web pages at <http://www.dhn.csiro.au>.

