Functional foods that may improve chronic diseases

Professor Lindsay Brown and his research group studied the impact of functional foods on chronic inflammatory conditions. They have identified several food groups, including purple fruits and vegetables, seaweeds, tropical fruits and coffee which have potential beneficial effects for human health.

Eating fresh, seasonal and local foods is encouraged by many dietary traditions, such as the Mediterranean diet. There is solid evidence that these foods lower the risks of cardiovascular and metabolic disease, cancer and cognitive decline. As these chronic diseases all include an activation of chronic inflammatory pathways and changes in the gut microbiota (the bacteria which live in our intestines), does an increased intake of plant-based foods improve health by suppressing inflammation and promoting a healthy gut microbiota? Disruption of prolonged inflammation by polyphenols in foods and a healthy gut microbiome with dietary fibre may also reduce age-related complications and improve tissue repair mechanisms.

FUNCTIONAL FOODS

The standard medicines for the treatment of inflammation include inhibitors of the arachidonic acid pathways such as the glucocorticoids and NSAIDs. However, foods also contain effective anti-inflammatory compounds. This suggests that functional foods, defined as foods which provide both nutrition and benefits to health, could reduce the symptoms of chronic inflammation.

Professor Lindsay Brown’s research group at the University of Southern Queensland is interested in harnessing the power of these functional foods to develop potential treatments for chronic diseases such as metabolic syndrome, which includes hypertension (high blood pressure), obesity and fatty liver, diabetes and insulin resistance, as well as inflammatory bowel disease (IBD), chronic kidney damage and osteoarthritis.

PURPLE FRUIT AND VEGETABLES

Recent research from Professor Brown and his team emphasises the use of whole foods in rat models of chronic human diseases, initially studying anthocyanin-containing fruits and vegetables. Anthocyanins, the compounds responsible for the blue, purple, red and orange colours seen in many fruits, show marked anti-inflammatory activities. The team explored whether symptoms of metabolic syndrome could be improved, using sources such as Queen Garnet plum, a new commercial variety with up to 10 times more anthocyanins than standard varieties. Queen Garnet plums fed to rats reduced the symptoms of metabolic syndrome, generated by a diet high in saturated fats and simple sugars including fructose and sucrose. Further, Queen Garnet plums reduced symptoms of IBD in rats given dextran sodium sulphate as effectively as the standard treatment with sulfasalazine. Other sources of the same anthocyanin, cyanidin glucoside, such as purple carrots, Saskatoon berries, blackberries and purple maize, were just as effective. The related anthocyanin, pelargonidin glucoside from strawberries, also reduced metabolic syndrome and IBD symptoms.

Indigenous fruits such as Davidson’s plum in Australia are potential sources of anthocyanins and other bioactive compounds. Professor Brown and his team showed that this fruit decreased signs of metabolic syndrome and, in additional studies, reduced obesity-induced degeneration of knee cartilage.

As these studies were in rats, the next step was to determine whether humans responded similarly to the anthocyanins. Professor Brown and his group explored whether Queen Garnet plum juice improved markers of inflammation in overweight subjects and reduced the mildly elevated blood pressure in these people. The findings showed that 12 weeks of Queen Garnet plum juice consumption reduced blood pressure, as well as fasting insulin and leptin concentrations which are often used as markers of metabolic health. Overall, this plum juice was just as effective as standard medications for lowering blood pressure and improving metabolic health in this participant group. Professor Brown highlights the importance of building on these findings with extended clinical trials in metabolic syndrome and other inflammatory diseases.

TROPICAL FOODS

Foods grown in tropical areas such as rice, fruits and seaweeds are important components of traditional diets. Nutritious tropical fruits, such as mango, mango-gooseberry, pineapple and avocado, may offer the same health benefits as anthocyanin-containing temperate fruits and vegetables.

Studies on potential health benefits of tropical fruits present more opportunities for identification of environmentally sustainable, cost-effective and commercially viable functional foods. One such example is mangosteen, whose pulp is often eaten but the rind is largely considered a waste product. The team showed that this rind was a good waste product, with the rind of this fruit being beneficial to gut, metabolic and immune health. The intervention with spent coffee grounds increased the diversity of the gut microbiota and the changes in gut microbiota correlated with the reduction in obesity and improvement in glucose tolerance and systolic blood pressure. So, the enjoyment of coffee as a beverage can be paired with the redirection of the waste product to improve our health.

Functional foods, defined as foods which provide both nutrition and benefits to health, could reduce the symptoms of chronic inflammation. These tropical fruits and foods include from left to right: purple mangosteen, achiote, Malabar tamarind, guava, mango, rambutan, dragonfruit, pineapple, coffee, Davidson’s plum, Borneo mango, banana, yellow mangosteen, coconut, papaya, brown and red seaweed.

Functional foods providing both nutrition and benefits to health include purple fruits and vegetables, tropical fruits and seaweeds that can be grown by local communities.

Prebiotics are generally a type of dietary fibre which feed the gut bacteria and promote growth of the ‘good’ bacteria which contribute to gut, metabolic and immune health. The intervention with spent coffee grounds increased the diversity of the gut microbiota and the changes in gut microbiota correlated with the reduction in obesity and improvement in glucose tolerance and systolic blood pressure. So, the enjoyment of coffee as a beverage can be paired with the redirection of the waste product to improve our health.

The human diet in Japan, Korea, China, Vietnam and the Philippines has included seaweeds, which have been considered healthy for hundreds of years but they remain under-utilised outside East Asia. Seaweeds provide a source of dietary fibre such as alginites and carrageenans. Rats supplemented with red seaweed showed decreased body weight, visceral fat, blood pressure and blood cholesterol. As with the anthocyanins, there was a reduction in the number of...
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One of the exciting possibilities is the development of agricultural and food waste to provide health solutions.

Chronic diseases, such as metabolic syndrome in developed countries, are disproportionately common in people from low socio-economic backgrounds, who may not have the budget to include these foods regularly in their diet. This shows that further work is needed to make functional foods accessible to all, including by finding ways to use agricultural and food waste.

Producing and processing foods produces large amounts of waste. The biofinery concept allows food products to be just one of many outputs from the growing of foods, leading to the eventual goal of zero waste from food production. The options are very broad, including the production of fertilisers, methane, bioplastics and biofuels, allowing economic benefits from materials that would otherwise be sent to landfill. Collaborations between researchers, engineers, business and governments could ensure optimal outcomes at reduced costs, so that these options remain feasible for local communities.

SUSTAINABILITY AND COMMUNITY PROJECTS

A varied diet, containing plenty of colourful fruits and vegetables, is the best approach for optimising health. Appropriate foods can be grown in most climates and may include indigenous plants, usually under-researched and under-utilised. The growing of health-giving plants can be a local initiative and the involvement of multinational companies is not necessary. This community involvement in growing the food can then be extended by community involvement in producing and storing the food, possibly using techniques developed over millennia. Such community projects on functional foods can build in sustainability for both food and health. While the benefits of functional foods are intuitive rather than proven, what is not yet clear, and what studies from Professor Brown’s team and others are beginning to show, is the extent of these benefits, the mechanisms for these beneficial effects of these foods in the body and which individual food components are most effective.

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