pseudocereals. The available evidence is largely inferential and based on laboratory studies. Favourable physiological responses have been demonstrated in animals, but randomised controlled trials in humans are few, small in scale and the findings inconsistent.
In contrast, elite cereal varieties with enhanced nutritional attributes, such as high-fibre barleys that deliver scientifically substantiated health benefits, are now either on the market or in the development pipeline. Importantly, these nutritional traits are expressed in high yielding modern cultivars. The resultant products show great promise in meeting growing consumer demand for healthier, affordable grain-based foods.
As wholegrains, pseudocereals are nutrient-dense foods that provide more options for consumers seeking to improve the nutritional quality and variety of their diets, especially individuals on a gluten-free diet. However, further research is required to elucidate and substantiate the health benefits of pseudocereals.
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SEAWEEDS AND THEIR SPECIALITY COMPOUNDS IN HEALTH AND NUTRITION

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Seaweeds, or marine macroalgae have long been a part of the human diet (1). Coastal harvesting and transport of macroalgae inland for food use still occurs today in South America. In this way, inland populations avoid iodine deficiency and enjoy sea vegetables in their diet. Marine macroalgae have also been used as medicines by ancient civilizations such as those at Monte Verde in Chile, a site that dates back an astonishing 12,000 years (2).
Marine macroalgae are a rich source of colloids that are used in foods and pharmaceuticals. The main commercial 'phycocolloids' are agar, alginate and carrageenan, familiar as thickening agents in foods. Aside from these colloids, there is a remarkable array of bioactives in current use or development. These include carbohydrate compounds such as β-glucan and fucoidan, in addition to pigments like fucoxanthin and polyphenols (3).
Marinova is an Australian manufacturer of fucoidan. Fucoidan is a non-gelling sulfated fucose rich polysaccharide found only in brown macroalgae. It is non-toxic, yet displays marked bioactivity as an anti-viral, anti-bacterial, anti-inflammatory and immunomodulatory compound. Several new studies point to potential as an adjunct to cancer therapies (4).
Historically, fucoidan was used as a selectin blocking agent. Selectins are cell surface receptors on white blood cells that perform a 'braking function' for the cells, allowing them to roll on an organs endothelial surface and ultimately enter that tissue space. Fucoidan inhibits 'P' and 'L' selectins and thus leukocyte adhesion and rolling thereby reducing inflammation in tissues. A new animal health product demonstrates this direct anti-inflammatory activity. Thoroughbred horses are at risk of gastric ulceration during periods away from a natural grazing environment and oral fucoidan has a calmative effect and reduces the need for pharmaceutical intervention.
The anti-viral activity of fucoidan is caused by receptor blocking activity, rather than a virucidal action. Fucoid an prevents the entry of viruses to cells, thereby preventing viral replication. Fucoidan from *Undaria pinnatifida* (commonly known as wakame), is a highly effective inhibitor of clinical strains of herpes viruses, including those resistant to acyclovir (4). A similar level of inhibitory activity is seen in strains of influenza viruses demonstrating fucoidan has excellent potential as an anti-viral agent.
Fucoidan also inhibits the adhesion of the stomach ulcer causative agent *Helicobacter pylori*. In recent studies, fucoidan compounds were demonstrated to significantly reduce adhesion to gastric cells *in vitro*. There is a need for novel approaches to treating *Helicobacter pylori* infection as resistance to current antibiotics increases. Fucoidan compounds offer a new strategy as adjunct therapies.
Fucoidan stimulates both innate and specific immunity and can be therapeutically useful. Immunomodulation by fucoidan has been reported by a number of research groups. For example, in a double blind placebo controlled trial, fucoidan increased the immune response to seasonal vaccination in an elderly population (5).
Lastly, a co-extracted fucoidan containing a large concentration of polyphenol has been developed by Marinova. This has a remarkable level of antioxidant activity directed against the superoxide anion - the main precursor of free radicals. This free radical neutralising activity together with the anti-inflammatory nature of fucoidan makes the extract therapeutically appealing. In a clinical trial with topical application of this extract, there were significant inhibitory effects of UV damage, in addition to significant reductions in age related pigmentation.
To conclude, whole seaweeds, and specialty compounds derived from seaweeds have great value in foods, supplements, pharmaceuticals and animal health applications. Future research into these compounds holds great promise for novel products.
Funding source(s): Marinova Pty Ltd.

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METABOLIC ENGINEERING OF OILSEED CROPS FOR THE PRODUCTION OF NUTRITIONALLY IMPROVED OILS

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Plant oils are an important source of dietary fat and represent as much as 25% of human caloric intake in developed countries. The current annual world production of plant oils is about 120 million tonnes, with a value of over US$65 billion, of which 86% is used for human consumption and the rest utilised in industrial applications. Fatty acids are the major constituents of plant oils and represent an impressive renewable resource of calories and nutrients. In nature there is an enormous diversity of fatty acids however current commercial plant oils are comprised of relatively few fatty acids. The ability to genetically engineer most commercial oilseed species and an explosion in the knowledge of genes controlling the synthesis of fatty acids have combined to enable the application of metabolic engineering for the production of plant oils with enhanced nutritional properties. This talk will discuss strategies being employing in the Oilseed Group at CSIRO for the development of nutritionally improved plant oils. These include the use of RNAi gene silencing for the creation of low saturated and low cyclopropane, highly monounsaturated forms of cottonseed oil.
I will also discuss the production of long chain *n*-3 PUFAs EPA and DHA in plant oil. Long-chain *n*-3 PUFAs such as EPA and DHA found in fish oil are recognised for their strong health benefits. These include cardiovascular protection, joint mobility and cognitive enhancement in infants. EPA and DHA are used in a wide range of applications ranging from aquaculture feed (fish do not synthesise these fatty acids but rather accumulate them in their diet), food nutraceutical additives, through to highly enriched pharmaceuticals. Demand for these fatty acids has grown rapidly and it is now recognised that wild-caught fish supply will not meet future demand. Demand for these fatty acids is growing rapidly and a sustainable source is required. Oilseed crops could provide a low cost, highly scalable solution if the native fatty acid pathways can be extended to produce marine-type *n*-3 fatty acids. The CSIRO Oilseed group has recently succeeded in metabolically engineering oilseeds to contain fish oil like levels of DHA. This work required the discovery (from algae), introduction and coordinated expression of transgenes encoding an entire biosynthetic pathway comprising seven discrete enzymatic conversion steps, one of the most complex pathway engineering so far achieved in plants. Progress in developing a DHA canola crop for commercialisation will be discussed.
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