Successful industrial applications

Lectures

L5.1

Recent successful plant based products

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Diet related diseases are a major health problem. It has been estimated that, cancer and coronary heart disease currently account for 60% of deaths and around a third are related to diet. Prevalence of obesity has trebled since the 1980’s and a quarter of the population are obese and half are overweight. There have therefore been significant efforts over the last 20 years to improve diet and never before has there been so much focus on healthy eating. In the same period, we have seen the emergence of functional foods, defined as foods that have health benefits over and above their inherent nutritional value. Originating in Japan, the most successful functional foods are primarily focused on addressing major health issues like high cholesterol and poor immune, gut and bone health and these represent dominant sectors in the global market estimated at $16.1bn. Gut health products dominate globally with a sector worth $6.8bn, heart health products account for $5.8bn and immune function products $2.6bn. The market is developing, however, and an increasing range of innovative products is being developed to address more specific health conditions and also to provide new products to meet changing lifestyle needs. The weight control sector for example is only quantifiable in Japan but with evidence of product activity in other countries means this is certainly set to change. Plant based functional foods are in important part of the market and there have been a number of successful innovations in this area. Heart health products are important in Europe, reflecting concerns over the high levels of death and illness caused by the disease. The heart health category has been driven by innovations in a number of key ingredient application areas including phytosterols and stanols, omega-3 fatty acids, soya, and dietary fibre. Increasingly, soya based products are being positioned on a cholesterol lowering platform too and a wide range of products from dairy products to soft drinks and cereal products are being fortified with omega 3 fatty acids. There is also a high level of interest in oat and barley beta glucans for cholesterol reduction and a number of breakfast cereal manufacturers have recently introduced new oat based variants of their cereal, for example Optivita from Kelloggs and Oatibix from Weetabix, both launched in 2006 in the UK. There is also renewed interest in the area of antioxidants with chocolate companies focusing on the antioxidant levels in chocolate, for example, Hershey’s Natural Flavanol Antioxidant Milk Chocolate in the United States and juice companies introducing Acai, pomegranate, goji and non-derived products boating high levels of antioxidants. The major emphasis in gut health products has been on probiotics, prebiotics and dietary fibre. Probiotic dairy products have led product development, firstly in terms of probiotic yoghurts and then via dose delivery probiotic drinks, which now represent the fastest growing sector in the market. Probiotics and prebiotics are being used increasing outside the dairy sector with significant innovation in terms of application in a broad range of products including bakery and cereal products and soft drinks. Despite considerable product activity, the global market for bone benefit foods remains small and fragmented. Calcium enrichment has been the most popular route for product development to date but there is also increasing interest in the application of other minerals, such as magnesium, as well as prebiotics and ingredients such as soya in bone health products. Spiralling levels of obesity and diabetes are stimulating demand for foods that might reverse the trend. Here we are not just talking about foods with lower calorie content but those with added ingredients that help suppress appetite in particular. Fabuless™ from DSM containing oat and palm oil has been used in a number of recent dairy launches including Adagio Versus from Lactogal in Portugal and Optiwell Control in Germany from Campina. Unilever are currently working with Phytopharm to develop a range of new weight management products containing *Lodina gordonii*, a satiety stimulator. In addition, green tea is finding increasing application in products aimed at weight control. In 2007, Unilever Switzerland introduced a catechin rich iced tea called Linea aimed at weight management and favourable fat distribution. Another emerging area is anti-ageing. The drive for people to stay looking younger for longer has prompted moves from some food companies into the beauty area and visa versa. Some plant based ingredients are being used in these products aimed at improving skin, including Aloe Vera, for example. In 2007, Danone introduced Essensis a range aimed at improved skin containing vitamin E, green tea, probiotics and borage oil. There is also an increasing focus on tailored nutrition, for example, nutritionally enhanced products to meet individual needs. A range of products is available in the United States and starting to appear over here. Women are a key target market and recent examples include Luna Sunrise, fortified bars aimed at women from Luna USA and Bloom, a soft drink for women from Del Monte US. Growing consumer acceptance of the link between diet and health and an increasing consumer responsibility for their own health are likely to be key drivers in the functional foods market of the future. Diet-related diseases remain a cause of premature death in the western world and a major burden on overstretched resources. Improving diet is therefore an opportunity for western govern-
ments to reduce spiralling healthcare costs. The ageing population and a desire to remain healthy into old age should also boost consumer interest in these products. Currently the market is predicted to outperform the food and drinks market as a whole as these foods become everyday shopping basket items for members of the increasingly health conscious population. Plant based ingredients are playing an important role in the development of a number of these innovative products.

L5.2

Phytosterols as cholesterol lowering food ingredients

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Coronary heart disease (CHD) is the leading cause of premature death worldwide. A major modifiable risk factor for CHD is widely recognised as the increased level of serum low-density lipoprotein (LDL) cholesterol. It is also agreed that dietary intervention, alongside changes in physical activity, is one of the best ways of reducing serum cholesterol and thus improving cardiovascular health. Phytosterols are naturally occurring constituents of plant materials that, when consumed in high quantities, inhibit the absorption of dietary and endogenously produced cholesterol from the small intestine, reducing the blood cholesterol concentration. Indeed, in the 1950’s high doses of phytosterols were used therapeutically to reduce cholesterol. As phytosterols are already a component of the human diet it made more sense for their effects on cholesterol to be explored as a dietary means to safely reduce serum cholesterol levels. However, the levels typically consumed in the diet are much lower than those that are needed to effectively lower cholesterol. To address this Unilever developed vegetable oil based spreads enriched with high levels of phytosterols (as the fatty acid ester) as a cholesterol-lowering functional food marketed under the brand name Flora/Becel pro. activ. Regulatory acceptance and successful marketing of such a novel functional food relied upon assurance of the safety and effectiveness of the product. Unilever carried out an extensive series of safety and efficacy trials to show that consumption of these products would be both safe and effective in lowering serum cholesterol. Efficacy studies showed that consumption of 2g of phytosterols per day significantly lowered LDL cholesterol levels by 10% within 3 weeks. An extensive package of safety study data demonstrated the safety of phytosterols at effective levels and enabled the regulatory approval of vegetable oil spreads in over 20 countries world wide and in the US the FDA has given no objection to the determination that phytosterol-esters are generally recognised as safe. Since the launch of the phytosterol-enriched spreads, Unilever and several other manufacturers have launched a range of phytosterol products including milk, yoghurts and yoghurt-based mini-drinks. A system of post marketing surveillance was introduced to ensure that over-consumption did not occur and to monitor any unforeseen adverse events. The system set up by Unilever has demonstrated that excessive consumption of phytosterols does not occur – despite the extension into several product formats. In conclusion, phytosterol-enriched food products have been successfully developed and launched in countries across the world. Consumption of these products as recommended has been established as a safe and effective dietary means of significantly reducing cholesterol.

Oral Communications

O5.1

Meat products Brassica® exploiting anticarcinogenic potential of cabbage phytochemicals: Polish path to bio-inspired foods

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Two recent decades marked the rise of a new approach to cancer control emphasizing rather prophylaxis, including the one involving dietary means (chemoprevention), as opposed to treatment (chemotherapy). A number of groups of phytochemicals present in food were identified displaying various activities protecting against malignant transformation or slowing down cancer development. Accordingly, vitamin (mainly antioxidant) supplements were suggested as possible anticarcinogenic agents and consumption of fruits and vegetables recommended as anticarcinogenic diet. On the other hand, also a number of foods were demonstrated to be associated with the increased risk of carcinogenesis. The most important among them are meat products, especially those based on thermally processed or cured red meat. Their consumption, as shown in a several epidemiological studies, increases the risk of the most common oncological diseases such as breast, prostate, colorectal and pancreas cancers. Since red meat based products belong to the most popular food items in all age groups, diminishing their carcinogenic potential appears to be of great public importance. Nonetheless, apart from decreasing fat content and recommending their minimal consumption, little is done in this regard. Our research on anticarcinogenic potential of traditional Central European dietary components suggested the way of meat processing that may lead to products with improved nutritional value, especially with cancer risk in mind. It is known from numerous studies that cruciferous vegetables prevent the development of several cancers, accidently (or not) the same cancers whose risk is associated with meat consumption. Our studies on cabbage showed that anticarcinogenic activities, such as induction of phase II or DNA repair enzymes, can be observed for the natural phytocomplex (namely juices) at concentrations that can be expected in alimentary tract after consumption of typical local dishes containing this vegetable. We have made also a number of observations pointing
to benefits of meat – cabbage mixture from technological point of view. The most important, also for cancer chemoprevention, are: the increasing antioxidative potential of cabbage upon heating, protection of animal fat against thermooxidative spoilage, very strong antimutagenic potential still retained after thermal processing of cabbage. All these processes restrict the formation of genotoxic compounds. Moreover, meat matrix rich in SH groups is capable of reversible covalent binding of isothiocyanates, volatile compounds with documented anticarcinogenic potential. Based on the knowledge of chemistry of cabbage phytochemicals, their health promoting activities and technological benefits, we have designed cured meat products enriched with natural anticarcinogenic compounds. These products have been introduced into Polish market under the trade mark Brassica® by Meat Company NOWAK this year. Meat products Brassica® are at least as microbiologically safe as regular counterparts. They are natural food items (not supplemented with isolated compounds which is typical for functional foods) prepared with specifically processed cabbage from organic farming to avoid introduction of environmental pollutants readily accumulated by cruciferous plants. The taste enhancing properties of cabbage enabled also cutting down salt content by about 30% without loss of palatable properties. Owing to low price of cabbage, the cost of meat products Brassica® is only about 50% higher compared to conventional products. To our best knowledge, Brassica® is the first line of “bio-inspired” meat products designed so as to exploit anticarcinogenic potential of cruciferous vegetables.

Posters

P5.1

Natural antioxidants vs. synthetic antioxidants: substitution and new approach

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Antioxidants are substances that when present in food or in the body at low concentrations compared to that of an oxidizable substrate markedly delay or prevent the oxidation of that substrate. In food, antioxidants occur either as endogenous constituents or are added for enhancing product quality by controlling oxidation with its deleterious consequences. The mechanism by which antioxidants protect food from oxidation is by scavenging of free radicals via donation of an electron or a hydrogen atom, or by deactivation of metal ions and singlet oxygen. The most widely used synthetic antioxidants in food are butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), propyl gallate (PG), and tert-butyldihydroquinone (TBHQ). These antioxidants may be added to food, individually or in combination, at a total level of up to 200 ppm on a fat basis. The use of synthetic antioxidants in food dates back some 60 years ago when BHA and then alkyl esters of gallic acid were first approved. It was also evident that the pro-oxidant effects of transition metal ions such as iron and copper had to be considered. Thus, certain acids such as citric acid (CA), ethylenediaminetetraacetic acid (EDTA) and polyphosphates, or their derivatives, were found to deactivate metal ions by chelating. These antioxidants and chelators have since been used in food, individually or in combination. However, concern has now been expressed about the safety of certain synthetic antioxidants as potential carcinogens. Therefore, there has been an interest by the industry and a desire by consumers to replace synthetic compounds with natural alternatives.

Naturally occurring inhibitors of oxidation in food generally originate from plant-based materials. The active components, namely phenolics and polyphenolics, including tocopherols, are secondary plant metabolites and are first derived from phenylalanine and in certain cases and in some plants from tyrosine. The resultant phenylpropanoids may then undergo further transformation to yield benzoic acid derivatives as well as flavonoids, isoflavons, and other complex polyphenols. Thus, natural food phenolics are present as a complex mixture of compounds that provide a cocktail of many active components present in the free, esterified, glycosylated and bound forms. The potency of preparations is therefore dictated by their chemical structures and governed by the hydrophilic-lipophilic balance of the participating molecules in a concentration- and system-dependent manner. Thus, the mode of action of natural antioxidants may involve multiple mechanisms, depending on the source material and possible presence of synergists and antagonists. This work provides a review of the functional role of natural antioxidants and how they can be effectively exploited by the food industry.

P5.2

Plant extracts and essential oils as potential natural antioxidants in preservation of food rancidity

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The purpose of this study was to evaluate different wild thyme species (Thymus, Lamiaceae) as a potential source of natural antioxidants. Phytochemical screening of plant extracts (diethyl ether, ethyl acetate, n-butanol) showed presence of flavonoids and phenolic acids, while the chemical analyses of different essential oils obtained by hydro distillation, point out the presence of monoterpene phensols and alcohols. The antioxidant activities of the extracts and the essential oils were determined using in vitro methods, based on the inhibitory effects of extracts.
and oils on DPPH (1,1-diphenyl-2-picrylhydrazyl) and hydroxyl radicals and protection of beta-carotene-linoleic acid model system. Caffeic and rosmarinic acid, luteolin, thymol, carvacrol, quercetin, BHA I BHT, green tea and sylimarin were used as reference substances. The investigated extracts showed strong radical scavenging activity. According to the results from the DPPH method, the extracts showed much better radical scavenging abilities ($IC_{50} = 9$-27 mg/ml) than the essential oils ($IC_{50} = 14$-167 mg/ml). The hydroxyl radical generation under the deoxiribose assay conditions was inhibited by the extracts from 32% to 52%. The discoloration process in the beta-carotene bleaching test with the Thymus ether and ethyl acetate extracts and its essential oils progressed in two different ways: short and weak inhibition of bleaching by the extracts (13-19% of initial value) and strong and prolonged inhibition of bleaching by the essential oils (28-60% of initial value). Diethyl ether and ethyl acetate extracts as well as essential oils from investigated thyme species were added to the antioxidant and peroxide free lard in purpose to measure the inhibition of lard thermal auto-oxidation, termostating the lard on higher temperature (60°C). Wheeler method was used as an accelerated method for monitoring the oxidative stability of lipids. The progress of the oxidation was observed by measuring the peroxide value. Obtained results indicated that extracts and essential oils obtained from some wild growing species of Thymus exhibit significant free radical scavenging, hydroxyl radical scavenging and antioxidant activity in vitro, which offer a possibility of using these plants as a source of natural antioxidants. The results of antioxidative protection of lipids as constituents of food were promising.