New Frontiers in Fibre - 10 Key Facts

1. The Scientific Advisory Committee on Nutrition (SACN) has recently reviewed the scientific evidence associated with the health benefits of dietary fibre (Draft Carbohydrates and Health report, 2014). A high fibre intake was found to be associated with lower incidence of cardiovascular disease, type 2 diabetes and colorectal cancer. An increase in the population recommendation for adults has been suggested, to 30g/day (measured by AOAC method). SACN also provided specific intake recommendations for children (15g/day [2-5 year olds], 20g/day [5-11 year olds], 25g/day [11-16 year olds] and 30g/day [16-18 year olds]).

2. Within the UK, the majority of adults are not meeting the current dietary fibre recommendation, which is equivalent to approximately 24g/day if measured by the AOAC method (average adult intake is approximately 18g/day AOAC fibre*). To understand if it is possible to reach the proposed recommendations within the context of a ‘normal’ healthy diet that meets other dietary guidelines, BNF has performed some simple dietary modelling. This demonstrates that it is possible to achieve 30g/day and to meet other nutritional requirements over a week but this would require strict adherence to a diet that included at least 5 portions of fruit and vegetables each day, based all meals on starchy foods and included regular consumption of wholegrain foods and high fibre snacks. However, the seven day menus devised were based on home cooked meals and included very few high fat/sugar foods either in meals or snacks. This diet is a long way away from current dietary patterns and would require significant changes to consumer behaviour.

3. Dietary fibre refers to a complex group of substances in plant foods which cannot be completely digested. Whilst digestible carbohydrates are absorbed and digested in the small intestine, non-digestible carbohydrates are resistant to hydrolysis in the small intestine and reach the large intestine (colon) where they are at least partially fermented by the diverse resident bacteria present in the colon. These bacteria are collectively called the gut microbiota. Some types of dietary fibre are almost completely fermentable by gut bacteria producing short chain fatty acids (SCFA), others are less fermentable and bind water increasing faecal bulk. In Europe, the term dietary fibre has been defined to include all non-digestible carbohydrates and lignin. This includes non-starch polysaccharides, all resistant starches, all non-digestible oligosaccharides with three or more monomeric units and other non-digestible, but quantitatively minor, components that are associated with the dietary fibre polysaccharides (especially lignin). One well-used approach for modulation of the gut microbiota composition is through the use of prebiotics defined as selectively fermented ingredients that allow specific changes, both in the composition and/or activity in the gut microbiota, that confer benefits upon host wellbeing and health.

4. The interaction between diet and the gut microbiome, and its importance to health, is increasingly being recognised. Dietary fibre has been reported to influence both the relative abundance and the metabolism of different types of gut microorganisms. Historically interest in the interaction between fibre and the gut microbiota has been focussed on its impact in terms of gut health (such as constipation) and more recently cardiovascular disease. However, emerging research suggests that there may also be potential effects for bone health and immune function. One of the most commonly proposed mechanisms is an increased production of short chain fatty acids (SCFAs) through bacterial fermentation of dietary fibre in the large intestine.
5. Calcium intakes are low in some groups in many countries. For example in the UK, around 1 in 5 teenage girls have calcium intakes below the Lower Reference Nutrient Intake** and this is of concern, especially with regards to bone health in later life. Typically in a mixed diet only around 30% of calcium is absorbed, principally in the small intestine. Therefore, identification of strategies to help increase calcium absorption is of interest. Emerging research has shown a significant correlation between increased intakes of certain dietary fibres (notably soluble prebiotic fibres), changes in the gut microbiota and increases in calcium absorption and bone mineral content in adolescents and post-menopausal women. It has been proposed that fermentation of prebiotics, such as soluble corn fibre, in the large bowel may influence mineral bioavailability by creating an environment that supports multiplication of the right types of gut bacteria. This could lead to an increase in the production of SCFAs and a subsequent decrease in luminal pH. The enhanced acidity may help to solubilise minerals, allowing calcium to be absorbed more readily. Other suggested mechanisms for prebiotics include an effect on intestinal morphology, increasing the surface area of the intestine and allowing for an increase in mineral absorption.

6. A limited number of in vitro studies, animal models and some human trials have shown significant effects, or at least positive trends, that support the hypothesis that certain types of dietary fibre can influence immune function. Both the effect and mechanism are likely to be dependent on the particular characteristics of different fibre types with variable polysaccharide structures, and may not be generally applicable to fibre. Some dietary fibres may be recognised by individual immune cell receptors, whereas other effects may be modulated via the gut microbiota and its metabolites. For example, SCFAs may potentially be key factors in anti-inflammatory pathways. There are only a few human studies in this research area and most lack sufficient power to demonstrate significant effects. Well-designed studies, with clear primary outcome measures, need to be performed to understand better the immunomodulatory effects of individual fibre types. Currently, consumers seem largely unaware of any potential benefit of dietary fibre for immune function and are more likely to recognise the impact of vitamins and minerals in this respect.

7. Systematic reviews show dietary fibre is associated with a reduction in cardiovascular disease. Cardiovascular disease has multiple risk factors and the mechanisms that underlie this relationship are likely to be complex. An increased consumption of both total and specific dietary fibres has been linked to altered lipid metabolism and reductions in insulin resistance and cardiovascular mortality, which may be in part through changes in the gut microbiota. Prebiotic fibres and increased SCFAs have been shown in some studies to improve microbial imbalance and reduce inflammation and body weight. Aberrant gut microbiota profiles have been associated with obesity and diabetes, and interrelated with the dietary factors that modulate this profile, may represent a novel cardio-metabolic risk factor. Thus dietary fibre intake may be a key determinant of the association between the gut microbiota and cardiovascular disease risk.

8. Most published studies have failed to demonstrate an effect of fibre manipulation on appetite. However, the majority of these studies did not examine long term effects on appetite or energy intake. Appropriately designed studies have shown fibre combinations and fibre-protein mixes to produce effects on appetite and reduce subsequent energy intake. Furthermore, fibre-containing products can be designed to trigger multiple satiation and satiety mechanisms, which may have implications for weight management. The effects of fibre on appetite need to be examined in the context of weight management and consumers’ day-to-day experience of the difficulties associated with a weight-loss diet. Hunger is a barrier to compliance with, and a
consequence of, a weight-loss diet. Identification of fibres that have a beneficial impact on satiety may support compliance with healthy eating behaviours and also may improve psychological well-being for those trying to control their weight.

9. Fibre is often used in the management of gastrointestinal disease in the clinical setting. However, the number and quality of studies investigating fibre in clinical practice varies widely depending upon the particular condition. In addition, the nature of the intervention (pharmaceutical preparations, food interventions, dietary advice) and the fibre type (soluble, insoluble, mixed) varies between studies. The evidence to support its clinical use in some conditions is relatively strong (such as the management of diarrhoea or constipation), whereas its use in others warrants additional investigation (e.g. in the management of diverticular disease, inflammatory bowel disease and radiation toxicity).

10. Irritable bowel syndrome (IBS) is a common life-long disorder of the gastrointestinal tract, affecting 10-15% of the UK population. Alterations in dietary fibre intake have been the mainstay of first-line dietary management of IBS for a long time. However, there is conflicting evidence both for increasing or decreasing fibre intakes within the different classifications of IBS; IBS with constipation IBS with diarrhoea mixed IBS, and unsubtyped IBS. Emerging dietary approaches that restrict certain fibres may have some benefit for IBS symptoms. The low FODMAPS approach includes the avoidance of fermentable carbohydrates, particularly fermentable oligosaccharides, disaccharides, monosaccharides and polyols. However, not all FODMAPs will be symptom triggers for all patients. Fructo-oligosaccharides (FOS) found in wheat, rye, onions, garlic and artichokes and galacto-oligosaccharides (GOS) found in legumes are fermented by intestinal bacteria. This results in some gas production and associated flatulence in all people; however in people with an altered gut flora, motility disorder or hypersensitivity, the outcome of bacterial fermentation can induce IBS symptoms.

Footnotes
* AOAC intake estimated by multiplying mean intake Non Starch Polysaccharides (NSP) fibre by 1.33
** The LRNI is the amount of nutrient that is sufficient to meet the needs of a small number of people in a population who have very low requirements (2.5%), and intakes habitually below this level are generally considered as inadequate for most individuals.

This is a summary from the British Nutrition Foundation conference ‘New Frontiers in Fibre’ held in London on 29th January 2015. Speakers were Sara Stanner (British Nutrition Foundation), Prof Connie Weaver (Purdue University), Dr Jurriaan Mes (Wageningen UR), Prof Julie Lovegrove (University of Reading), Prof Jason Halford (University of Liverpool), Prof Kevin Whelan (Kings College London) and Yvonne McKenzie (Clinical Dietitian). The conference was chaired by Prof Kevin Whelan (Kings College London).

The British Nutrition Foundation (BNF), a registered charity, delivers impartial, authoritative and evidence-based information on food and nutrition. Its core purpose is to make nutrition science accessible to all, working with an extensive network of contacts across academia, education and the food chain, and through BNF work programmes focussing on education in schools and nutrition science communication. The key role of BNF’s Council and Trustees is to ensure that the Foundation delivers its charitable aims, is impartial, transparent and acts with integrity. BNF’s Articles of Association require a majority of Council’s members to be leading academics from the nutrition science community, supported by leaders in education, communication and the food chain.

For more information about the conference and the British Nutrition Foundation, please see our website:
http://www.nutrition.org.uk