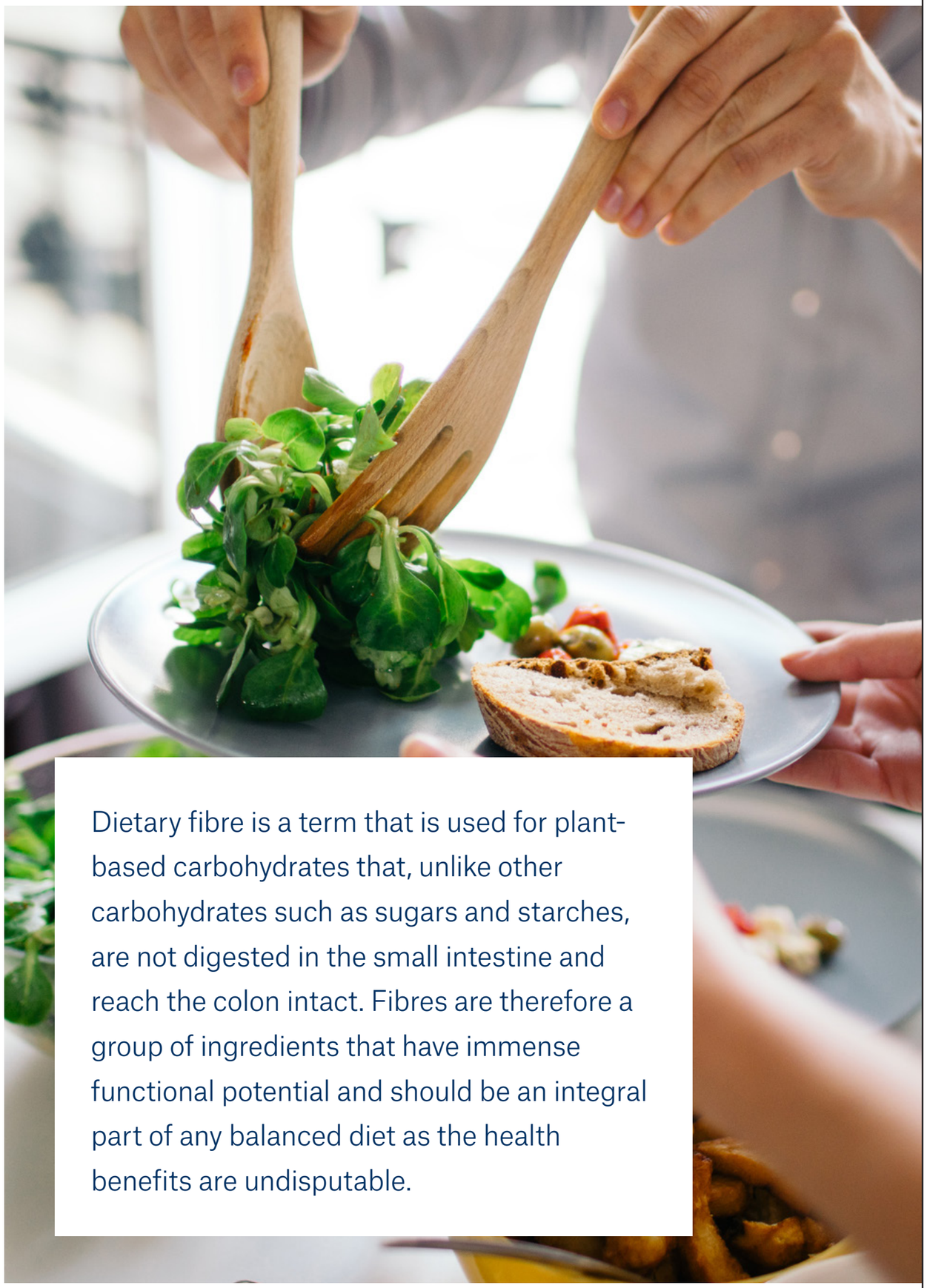
In focus

Dietary Fibre: the forgotten hero with so much potential

leatherhead food research

a **science group** company



Dietary fibre is a term that is used for plant-based carbohydrates that, unlike other carbohydrates such as sugars and starches, are not digested in the small intestine and reach the colon intact. Fibres are therefore a group of ingredients that have immense functional potential and should be an integral part of any balanced diet as the health benefits are undisputable.

Consumers have a growing awareness of the positive effects of increased fibre consumption and are ready to discover more ways to include it in their diet. For the food and beverage companies, fibres are turning into a selling point, and novel applications are emerging, providing added value for consumers. Whilst it can be a long journey from developing a brand-new ingredient, pushing it past the regulatory hurdles and establishing it in the consumers' field of interest, harnessing fibres' potential is an exciting challenge with promising pay-offs.

This white paper will help you get to grips with why dietary fibres are so important, what consumers think about them, and how this can help in the design of persuasive marketing communications demonstrating their benefits. In addition, this white paper provides an overview of the recent technological developments and challenges within the dietary fibre space, leading the way for the introduction of high-fibre products with high quality physico-chemical and organoleptic attributes.

To meet the new 30g of fibre per day recommendation this would mean that consumers would need to eat 3 to 5 servings of fibrous vegetables, for example peas, carrots or spinach, 2 to 4 servings of fruit and 3 servings of wholegrain bread, pasta, beans or pulses

1.0 So why is fibre important and how much should we be eating?

Back in 2015 when the Scientific Advisory Committee on Nutrition (SACN) launched its Carbohydrates and Health report[1] the media focus was solely on sugar, the emergence of free sugars and reduced intake targets, plus reduction in fizzy drink consumption. However, this same report also contained important guidance for increasing the fibre content of everyone's diets.

Recommended fibre intakes:

Old intake target
18g/day

(Englyst method – older UK standard, including non-starch polysaccharides)

New intake targets
30g/day

(AOAC method – newer global standard, also includes lignin and resistant starches therefore increasing fibre values by about one third

This increase equates to eating around 12g more fibre per day than the previous intake levels for people 16 and over. This is a tall order based on today's diet and would mean that men would need to be eating around 50% more fibre and women in the region of 75% more than they are currently.

To put this into context, in order to meet the new 30g/day recommendations this would mean that consumers would need to eat 3 to 5 servings of fibrous vegetables, for example peas, carrots or spinach, 2 to 4 serving of fruit and 3 servings of wholegrain bread, pasta, beans or pulses.

Therefore, there is a big opportunity for product developers to incorporate more fibres into products for nutrition and health as well as functional benefits.

With respect to children, new targets have been set, as shown in Table I:

Table 1: Dietary fibre intakes, as recommended by the SACN

Age Group	SACN recommended intake/day
2 to 5 years	15g
5 to 11 years	20g
11 to 16 years	25g

Most recently the Lancet published a meta-analysis[2] in January 2019 which looked at nearly 250 studies and clinical trials with 4635 participants, showing positive effects of a high fibre diet on:

- cardiovascular disease
- coronary heart disease
- stroke
- type 2 diabetes
- colorectal cancer
- lower bodyweight
- blood pressure
- total cholesterol levels

Also, there is strong evidence that fibres promote gut health by acting as a prebiotic to support the growth of desirable bacteria as part of the gut microbiome.

1 **Soluble fibre** attracts water to form a gel like substance and slows down digestion. It includes pectins and beta glucans found in fruit and oats.

2 **Insoluble fibre** adds bulk by absorbing water during its passage through the digestive tract and helps to move waste products more efficiently. Found in wholegrains, wheat bran and vegetables.

Some nutrition scientists argue that these terms are no longer relevant, however they are important from a product development perspective.

So what are dietary fibres?

Dietary fibres are carbohydrates that are not digested in the small intestine. Instead, they are broken down in the large intestine by bacteria, fermented or excreted. They are defined in the UK and Europe as:

All carbohydrates that are naturally integrated components of food that are neither digested or absorbed by the small intestine and have a degree of polymerisation of 3 or more monomeric units, plus lignin.

The Codex definition is similar but includes carbohydrates with 10 or more monomeric units. Resulting from the review of scientific papers in the SACN report in 2015 the dietary fibre definition was extended to include non-digestible oligosaccharides, resistant starch and polydextrose.

[1] Scientific Advisory Committee on Nutrition (SACN), 2015. Carbohydrates and Health Report, Scientific Consultation. Public Health England, London.

[2] Carbohydrate quality and human health: a series of systematic reviews and meta analyses. Andrew Reynolds, Jim Mann, John Cummings, Nicola Winter, Evelyn Mete, Lisa Te Morenga. Lancet volume 393, Issue 10170, p.434-445. February 2nd 2019

2.0 What do consumers think about fibres?

In a recent on-line consumer survey from Leatherhead Food Research, amongst 1025 respondents, 75% think that they should be eating more fibre in their diet[3] but are struggling with ways to do this. Leatherhead undertook a similar on-line consumer survey looking at fibre amongst 1366 respondents in 2017[4] and this recent survey [in 2019] allowed us to compare the consumer awareness of fibre over the last two years. Understanding consumer perceptions of fibre is essential for all product developers trying to increase the health attributes of their products through using different types of fibres, as well as for marketing teams to identify optimal ways of communicating the inclusion of fibres and its benefits. In the 2019 survey, 57% of respondents would like to see more natural and tasty high fibre products and 46% would like to see a wider range of higher fibre products, for example whole and white.

In 2017, most consumers were aware of the health benefits of eating fibre including improving digestive health, preventing constipation and improving bowel-related health problems. The fibres that respondents were most aware of were pectin, wheat bran and cellulose. They were less familiar with substances such as beta-glucan, polydextrose, inulin, psyllium and pea fibre. Two years on in 2019 this has remained the same in that awareness has not increased. This is surprising as in particular inulin has been used extensively across many food categories to reduce the sugar content of products. In both surveys respondents indicated they would consider eating products containing all these types of fibres, except for polydextrose and Methyl cellulose, and this may be due to the chemical-sounding nature. The main sources of fibre in respondents' diets, as shown in the 2017 survey, were fruit and vegetables, wholegrain pasta and bread, as well as beans and pulses. In 2019 breakfast cereals were also added to the list. In both surveys the key product categories consumed for their fibre content were fruit and vegetables, breakfast cereals and bread products. Breakfast was by far the most popular meal to eat fibre. This finding indicated that there is opportunity to increase the fibre content of other meals, and nearly 40% in 2019 stated that they would like to increase their fibre intake at any time of day. In terms of product categories respondents in 2019 would like to see the fibre content increase in breakfast cereals (52%), bread (53%), ready meals (34%), cakes and biscuits (33%) and dairy products (24%).

The main sources of fibre in respondents' diets, as shown in the 2017 survey, were fruit and vegetables, wholegrain pasta and bread, as well as beans and pulses. In 2019 breakfast cereals were also added to the list.

3.0 How can you communicate the benefits of fibre in products?

In the EU, to encourage consumers to increase their fibre intake and select products with a higher fibre content, there are a number of nutrition and health claims that can be used to promote the products, but only if the provisions are met.

Where a nutrition claim is being used, there are no distinctions between fibres naturally occurring in the food or those that have been added by the manufacturer to boost nutritional value, nor does the legislation distinguish between different types of fibres. Thus, a product developer would need to formulate a recipe that would contain the right amount of fibre, as shown in table 2.

If producers want to be more specific about the health benefits of their products and go beyond a broad 'high fibre' claim, the situation becomes more complicated and more requirements must be met. In the EU at present, 'health claims' are only permitted for specific fibres for which a health benefit has been scientifically proven in such a way as to satisfy the strict requirements of the European Food Safety Authority (EFSA).

Currently, when used under certain conditions, there are about 30 health claims for various kinds of fibres authorised in the EU. Of these, only 8 claims are permitted for generic components such as 'wheat bran fibre' or 'dried plums', while, in comparison, 5 claims are authorised specifically for beta-glucan alone, a soluble fibre found in oats and barley. This demonstrates that a major issue when it comes to approving claims is the establishing of scientific evidence. For substances such as fibre it is difficult to prove that an effect stems from a vaguely defined mixture of substances, whereas beta-glucan, for example, is well-described, thus allowing scientists to clearly outline test parameters and evaluate the outcome of their studies.

Table 2: Provisions that need to be fulfilled when making a nutrition claim on the back of fibre contents.

Type of claim	Provisions
Source of fibre	3g of fibre/100g or 1.5g/100kcal
High in fibre	6g of fibre/100g or 3g/100kcal
Naturally high in fibre	A food meets the high in fibre criteria and has not been processed e.g. nuts, seeds

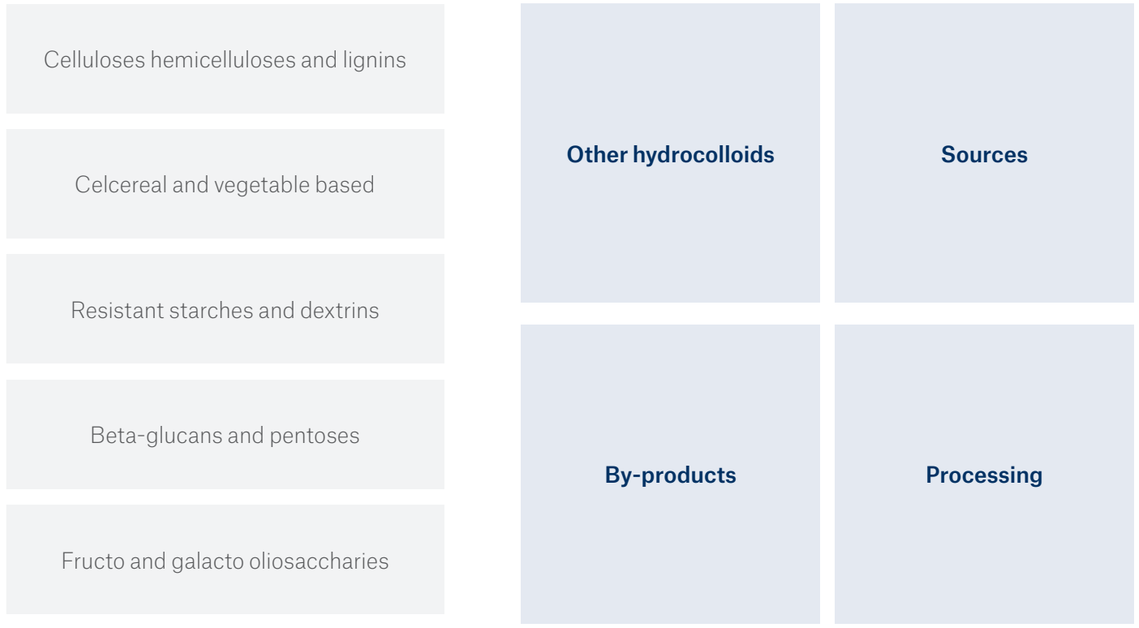
[3] Leatherhead consumer research – Consumer Awareness of Fibre – April 2019 – sample size 1366
[4] Leatherhead consumer research – Consumer Awareness of Fibre - October 2017 – sample size 1025

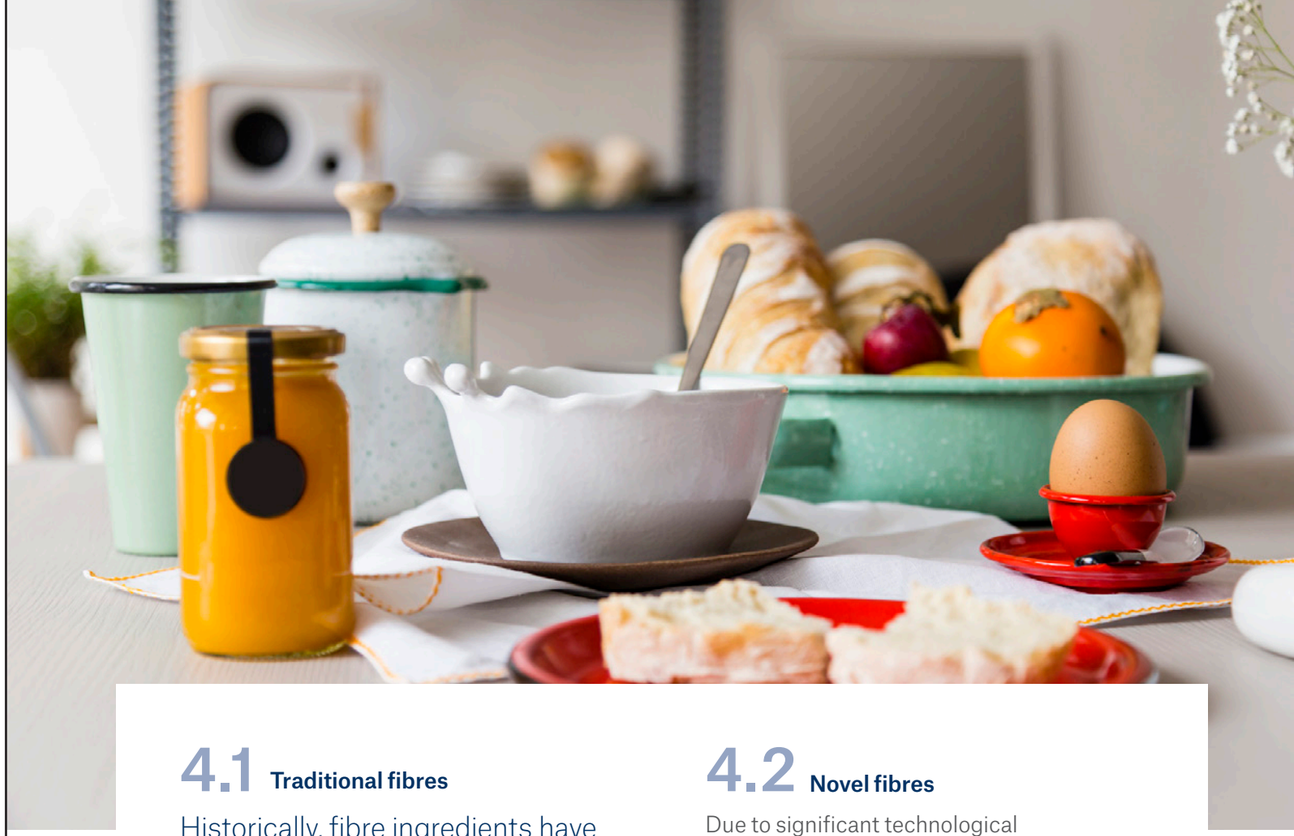
4.0 How can you incorporate more fibres into your products?

At the moment, there is a plethora of "traditional" dietary fibres available on the market (Figure 1), and these are not only used in food production for their dietary value; the majority are used for their physical properties. Fibres are a versatile ingredient with a wide palette of thickening and viscosity-influencing properties, gelling characteristics, bulking properties and emulsifying effects. Aside from replacing other bulk ingredients such as sugar in sugar-reduced formulations, fibre is particularly promising in the field of fat reduction: it can be very difficult to replace fat components during a product reformulation project, but certain types of fibre display a potential to preserve the textural component and mouth-feel of fats while providing significantly less energy – on average only 2 kcal per 100g instead of 9 kcal per 100g.

In addition to traditional dietary fibres, there have been significant technological developments in the development of new/emerging dietary fibres, which have been designed to overcome the restrictions that traditional fibres have.

Figure 1: Overview of traditional and new/emerging fibres





4.1 Traditional fibres

Historically, fibre ingredients have been mostly plant-based and were obtained from cereals, vegetables and other sources. Fibres such as pectin have a long tradition in applications such as jam-making. Many fruits are naturally high in this fibre, but it may be necessary to add more for standardisation purposes and to guarantee the desired gel structure. Cellulose and its derivatives are popular viscosity-influencers, supporting a thick, creamy texture in paste-like products. Resistant starches are inexpensive and can be custom-built for a specific purpose. Citrus fibre is a popular choice in fat replacer applications due to its water-binding and emulsification characteristics, which give it the ability to simulate the typical mouth-feel of fat and help preserve structural characteristics. Inulin and beta-glucan are popular dietary fibres for increasing the nutritional value of products.

4.2 Novel fibres

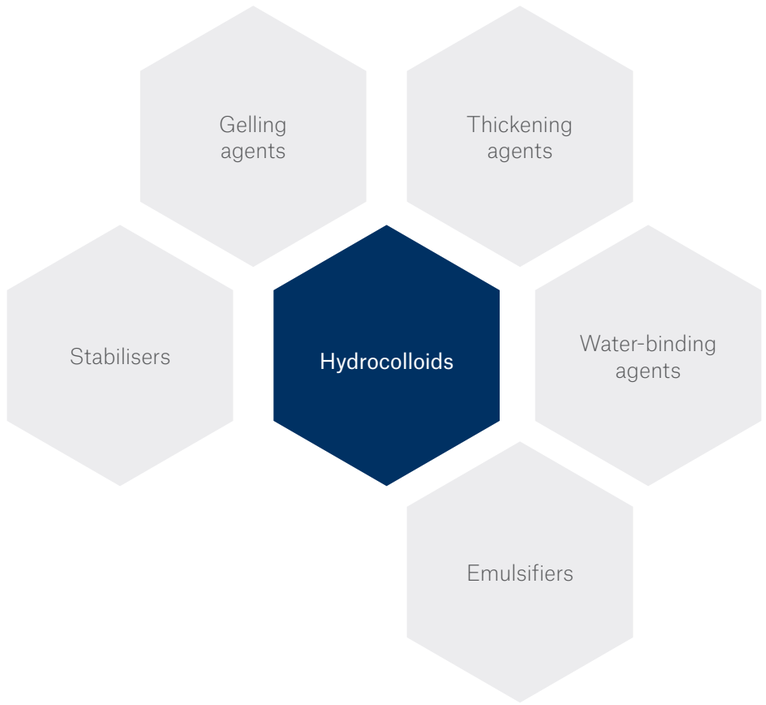
Due to significant technological development, novel fibres can open up new possibilities for the use of fibres. There are several angles that can be explored in the search for novel fibres.

4.2.1 Hydrocolloids and gums

Hydrocolloids or gums (figure 2) are polymers originating from plants as well as animal and microbial sources. Traditionally, their main uses revolve around their water-binding and emulsifying properties (Figure 1). Examples of such substances are alginates, carrageenan or guar gum. However, these are not widely promoted as dietary fibres and are generally used in low concentrations as food additives due to their superior gelling and thickening properties, which make them difficult to apply at concentrations that would be physiologically beneficial. Other challenges when using these as opposed to more traditional fibres are the association with e-numbers and the expensive prices.

However, obstacles such as high viscosity can be overcome, and research is being conducted on existing hydrocolloids to develop solutions. An example is the hydrolysation of guar gum, which is a method emerging from depolymerisation technology to reduce the molecular weight distribution and thereby modify and mitigate the technological effects the addition of these hydrocolloids may have. This can be done by chemical or enzymatic treatment, thermal or mechanical processing, ultrasonic exposure or even irradiation. For example, Sunfibre is partially hydrolyzed guar gum which is a variation of guar gum with an 80% dietary fibre content with low viscosity. Hydrolyzation – this is a controlled natural enzymatic process that breaks guar gum down into small units. For example, 5% hydrolysed gives viscosity of ~7 – 12 cps whereas 1% standard guar gum gives a viscosity of 5000 cps.

Figure 2: Properties of hydrocollids



4.2.2 Alternative sources for fibres

Instead of the modification of the chemical structure of existing fibres, new sources of fibre can be sourced and investigated. Examples are bamboo fibre, chitin and chitosan, psyllium husks or konjac. In the process of uncovering lesser known dietary fibres, awareness for their existence must be heightened in order to increase the potential for commercialisation. A positive aspect of this route is that fibres may create a more 'natural' impression with the consumer and they may be cheaper and easier to procure, being sourced from existing commodity flows. This especially applies if products that have previously been viewed as waste are utilised. Many by-products of plant production are already known sources of bioactive compounds and dietary fibres, such as seeds/kernels, stems, husks or skins. By developing such by-products into fibres, added value is created for producers and consumers alike.

Lastly, consideration also needs to be given to the price of novel fibres; depending on the source or how complicated the production process is, a fibre component can be quite expensive. Sourcing issues must also be considered when developing formulations with new fibres. If there is a limited number of suppliers or the raw material is not readily available, it may be risky to choose a certain ingredient.

4.2.3 Use of by-products

There are a range of by-products from plants that can be used as they are known sources of bioactive compounds and dietary fibres including:

Seed	Husk
Skin	Core
Pod	Stone
Peel	Stem
Pomace	Rind
Hull	Kernel

Table 3 shows how by products can be used in foods[5]

Table 3: Exploitation of by-products

By-product	Sources	Examples of products
Pomace	Apple, pear, kiwi, rapes, pumpkin, carrot	Bread and buns
Peel and pulp	Orange, mesquite, okra, cucumber, banana, peel, potato	Biscuits, cookies, breads and buns
Seeds	Dates, hemp, apricot	Biscuits and cookies
Oil cake	Olive, soybean	
Stems	Cauliflower, artichoke	
Hulls, pods and husks	Cocoa, pea, sunflower, chickpea	Breads and buns
Bran	Oats, rice, corm	Meat products, noodles
Algae/seaweed	Nori, arame	
Others	Distillers grain, cider wastes, asparagus by-products, washing water of orange processing	

[5] Sharma, S. K. et at (2015) Utilisation of food processing by-products as dietary, functional and novel fibres Critical Reviews in Food Science & Nutrition 56 pp. 1647-1661

Table 4: Processing technologies for new and emerging ingredients

Processing methodologies	
Mechanical degradation	Disrupt the molecular structure of fibres including grinding
Extrusion cooking	Combination of high temperature, pressure and shear force
High and ultra-high pressure	High pressure in a short space of time
Chemical	Acidic and alkali treatments
Enzymatic and microbial	Environmentally friendly treatments
Mixtures	Combinations of the above

4.2.3 Processing

Table 4 shows the range of processing techniques available to produce new and emerging ingredients[6]. More details of these are available on the recording of the new and emerging ingredients webinar, available on the website.

5.0 Regulatory challenges when using novel fibres

Once established as a working solution, there are however, still some challenges to overcome. From a regulatory perspective, in the EU market ingredients and substances that have not been used for human consumption to a significant degree before 15th May 1997 are typically considered as novel foods/food ingredients. This means that any products that have been processed in new ways or have been subjected to novel treatments, including the novel fibres mentioned above, will require pre-market authorisation. The Novel Food Regulation (EC) 2015/2283 lays out the process that the applicants will have to comply with, leading towards the submission of a dossier to the EC. The novel fibres must be safe for human consumption, labelled appropriately (so as not to mislead the consumers) and must not differ from the food it intends to replace in such a way that its normal consumption would be nutritionally disadvantageous for consumers. Furthermore, compliance of the products with the provisions put forward by the Regulation (EC) 1924/2006 is another essential step that must be undertaken by product developers seeking to put nutrition and health claims on their products.

[6] Yang, Y-y. et al (2017) Modification and application of dietary fibres in foods Journal of Chemistry Article ID 9340427

6.0 Conclusion

With the increasing targets and consumer awareness of its health benefits, there is appetite and opportunity for NPD and EPD using dietary fibres. There are limited claims that can be made but consumers are increasingly interested in high fibre claims and products with a higher fibre content. There is a range a new and emerging ingredients that have functional as well as health benefits; fibres are a very versatile ingredients used currently in sugar reduction but with promising effects for fat reduction. In essence, dietary fibres are the forgotten hero with so much potential.

7.0 What is Leatherhead doing?

In 2018 Leatherhead was part of the Institute of Grocery Distribution's (IGD) Expert working group on fibre and helped to develop the IGD's Fibre technical guidance document, 'Fibre join the movement', looking at ways of increasing the fibre content of products.

https://www.igd.com/charitable-impact/healthy-eating/reformulation/reformulating-with-fibre

About Leatherhead Food Research

Leatherhead Food Research provides expertise and support to the global food and drink sector with practical solutions that cover all stages of a product's life cycle from consumer insight, ingredient innovation and sensory testing to food safety consultancy and global regulatory advice. Leatherhead operates a membership program which represents a who's who of the global food and drinks industry. Supporting all members and clients, large or small, Leatherhead provides consultancy and advice, as well as training, market news, published reports and bespoke projects. Alongside the member support and project work, our world-renowned experts deliver cutting-edge research in areas that drive long term commercial benefit for the food and drink industry. Leatherhead Food Research is a trading name of Leatherhead Research Ltd, a Science Group Company.

help@leatherheadfood.com

T. +44 1372 376761

www.leatherheadfood.com

About Science Group plc

Science Group plc offers independent advisory and leading-edge product development services focused on science and technology initiatives. Its specialist companies, Sagentia, Oakland Innovation, OTM Consulting, Leatherhead Food Research and TSG Consulting collaborate closely with their clients in key vertical markets to deliver clear returns on technology and R&D investments. Science Group plc is listed on the London AIM stock exchange and has more than 400 employees, comprised of scientists, nutritionists, engineers, regulatory advisors, mathematicians and market experts.

Founded in 1986, Science Group was one of the founding companies to form the globally recognised Cambridge (UK) high technology and engineering cluster. Today the Group has 12 European and North American offices.

info@sciencegroup.com

www.sciencegroup.com

leatherhead food research

a **science group** company