eurofins | Food Testing

Carbohydrate Competence Centre Technical Brochure

Dietary fibre
What is it and how to measure it correctly

Introduction

It is generally recognised that dietary fibre is an essential dietary requirement for human beings. In our western world the daily intake of dietary fibre is considerably less than the recommended daily intake (about 35 g). It is well documented that dietary fibre is related to health benefits such as weight control, satiety, prevention of constipation, stabilization of blood-glucose levels, reduction of cholesterol levels, prevention of certain types of colonic cancer and prebiotic activity. Nowadays, the demand for healthier and less chemically modified food ingredients and foods is becoming more and more important for the consumer. Dietary fibre has a crucial role to play in this context.

Though dietary fibre is often associated with fruits, vegetables and grains, a range of a new-generation industrially prepared foodstuffs with added dietary fibre are currently commercially available: e.g. bakery products, infant formulas and baby food, pasta products, beverages, as well as feed and pet food. Many new products are launched with claims about their dietary-fibre content and beneficial health effects. Manufacturers enrich their products with different types of fibres like inulin, fructooligosaccharides (FOS), polydextroses, and galactooligosaccharides (GOS). Resistant starch, resistant maltodextrins and β-glucans are also considered as dietary fibre and added to food products. For those reasons, product quality control has become very important and has led to the need to determine the amount of dietary fibre contained in products and ingredients. A correct measurement of the dietary fibre content is important in relation to:

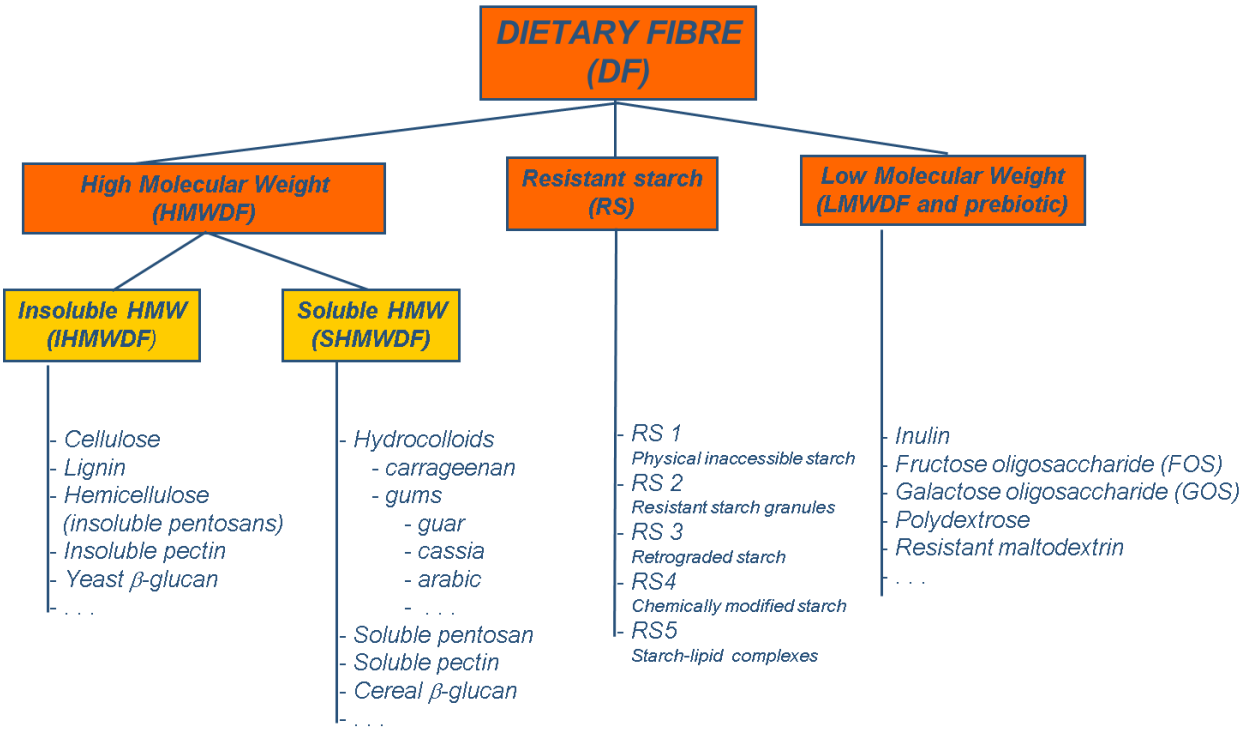
- Correct labelling of the product
- Decisions on granting label and health claims
- Too low dietary fibre content in a product is always accompanied with too high energy values of the product

In this technical brochure the subdivision of dietary fibres in different categories is given, the most frequently used analytical methods for the determination of (different categories) dietary fibre are shortly discussed and a decision tree is presented in order to select the correct analytical method(s) for the determination of the total dietary fibre content.

Dietary Fiber definition

In principle, dietary fibre is a term that refers to a group of food constituents that pass undigested through the stomach and the small intestine and reach the large intestine virtually unchanged. It is made up of indigestible parts of plants and is mainly composed of different types of non-starch polysaccharides (NSP) and lignin.
The exact definition of dietary fibre has been subject of much discussion and controversy. In 2008 the CODEX Committee on Nutrition and Foods for Special Uses updated the terminology of the dietary fibre

definition. The EU adopted the definition of the CODEX Alimentarius with the remark that carbohydrate polymers in the dietary fibre should consist of at least three or more monomeric units (2008/100/EC, annex II, October 28, 2008). As visualized in Scheme 1, dietary fibre constituents can be subdivided in different categories depending on their molecular weight and solubility.



Scheme 1: Dietary Fiber constituents

Firstly, the high molecular weight dietary fibres (HMWDF) which can be subdivided again into soluble and insoluble high molecular weight dietary fibres. Secondly, the resistant starch (RS): five different categories of resistant starch are distinguished, being RS1, RS2, RS3, RS4 and RS5. Finally, there is the category of low molecular weight dietary fibres (LMWDF): all different prebiotics belong to this group. Scheme 1 shows also typical dietary fibre constituents that belong to each of the different DF categories.

Energetic value and health claims

Dietary fibres play an important role in the human nutrition. It has an energetic value of 2 kcal/g (8kJ/g). Erroneously too low established dietary fibre contents are always accompanied by erroneously too high (calculated) carbohydrate contents and thus with a too high energetic value of the product.

Depending on the total dietary fibre content and its specific constituents different health claims are allowed. Depending on the DF content, products can be claimed with ‘source of fibre’ or ‘high fibre’ (EU1924/2006). Also various health claims related to blood cholesterol, bowel function and faecal bulking are already accepted by EFSA. For this reason it is important to measure products with the right method.

Analytical methods

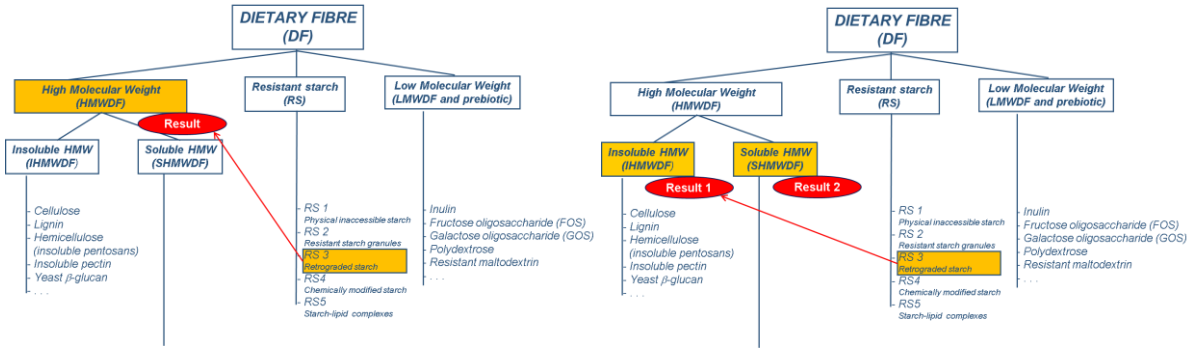
A variety of different methods have been applied for total dietary fibre determination in food. The so called Porsky method (AOAC 985.29) is not always the “golden method” of choice for the measurement of total dietary fiber since, nowadays, a large number of different types of DF ingredients, which are not captured by that method, is available on the market.
Some of the most common analytical methods for dietary fiber analysis are shortly discussed.

AOAC 985.29: classical total dietary fibre

For samples for which it is known that they don’t contain LMWDF, it is possible to perform the classical AOAC 985.29 method. However one should be aware that this test excludes, next to LMWDF, also most of resistant starch categories. Only RS3 will be incorporated in the test result.

AOAC 991.43: total, soluble and insoluble high molecular weight dietary fiber

Similar to AOAC 985.29, the AOAC 991.43 method can be applied to samples for which it is known that no LMWDF is present. The method provides differentiation between soluble and insoluble HMWDF (sHMWDF and iHMWDF respectively). Similar to AOAC 985.29, this method excludes most types of the resistant starch dietary fibre. The sum of both results is the total dietary fiber (TDF) content.



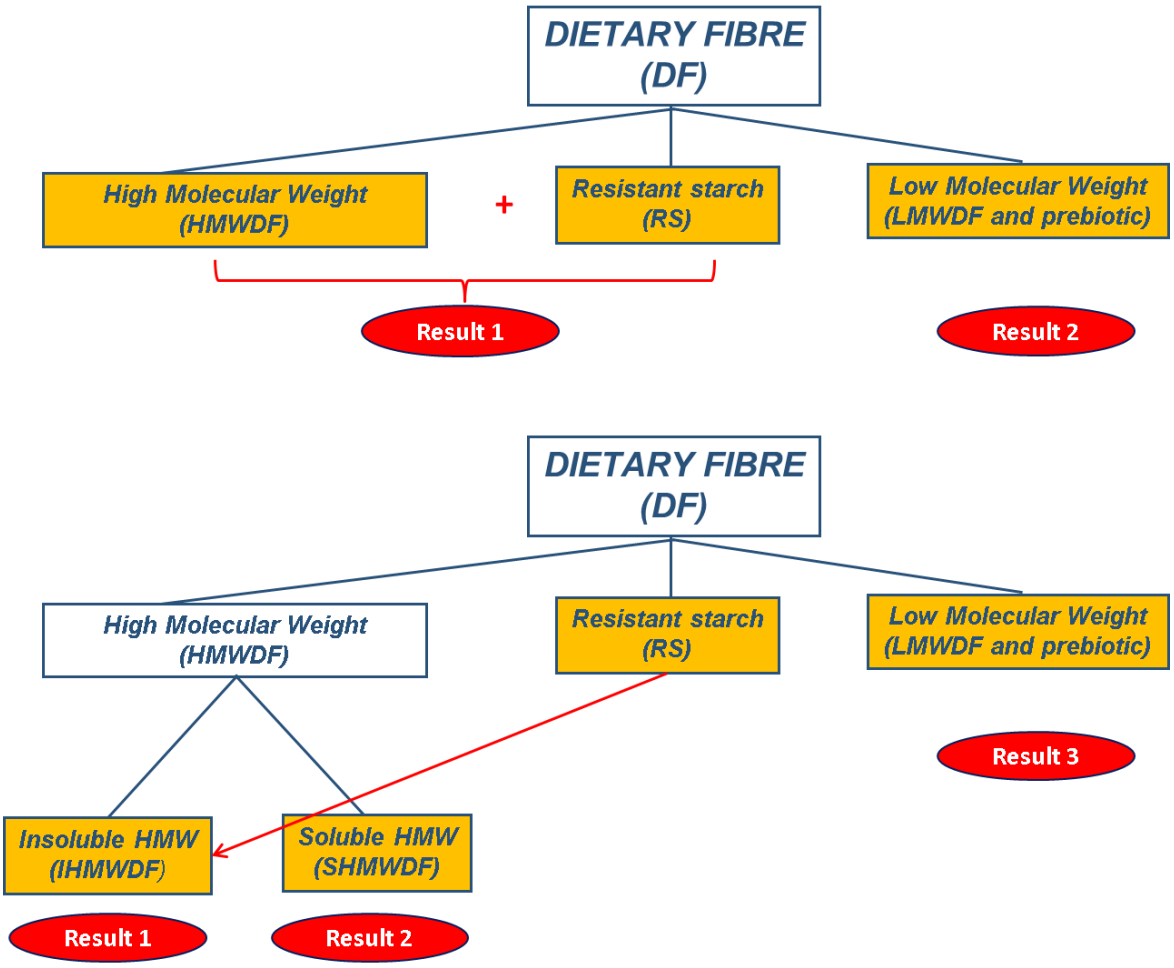
Scheme 2: Results obtained when AOAC 985.29 (left) or AOAC 991.43 (right) is performed.

AOAC 2009.01 dietary fibre analysis

In the AOAC 2009.01 analysis both the total HMWDF content, including the resistant starches and the LMWDF content are measured and reported. The sum of both results is the total dietary fibre (TDF) content.

AOAC 2011.25 dietary fibre analysis

In the AOAC 2011.25, which is an extended AOAC 2009.01 method, differentiation between 3 categories of dietary fibre is made: (1) insoluble high molecular weight dietary fibres (iHMWDF) including the resistant staches, (2), the soluble high molecular weight dietary fibre (sHMWDF), and (3) the low molecular weight dietary fibres (LMWDF) or prebiotics. The sum of all results is the total dietary fibre (TDF) content.



Scheme 3: Results obtained when AOAC 2009.01 (above) or AOAC 2011.25 (bellow) is performed.

Decision tree analytical methods

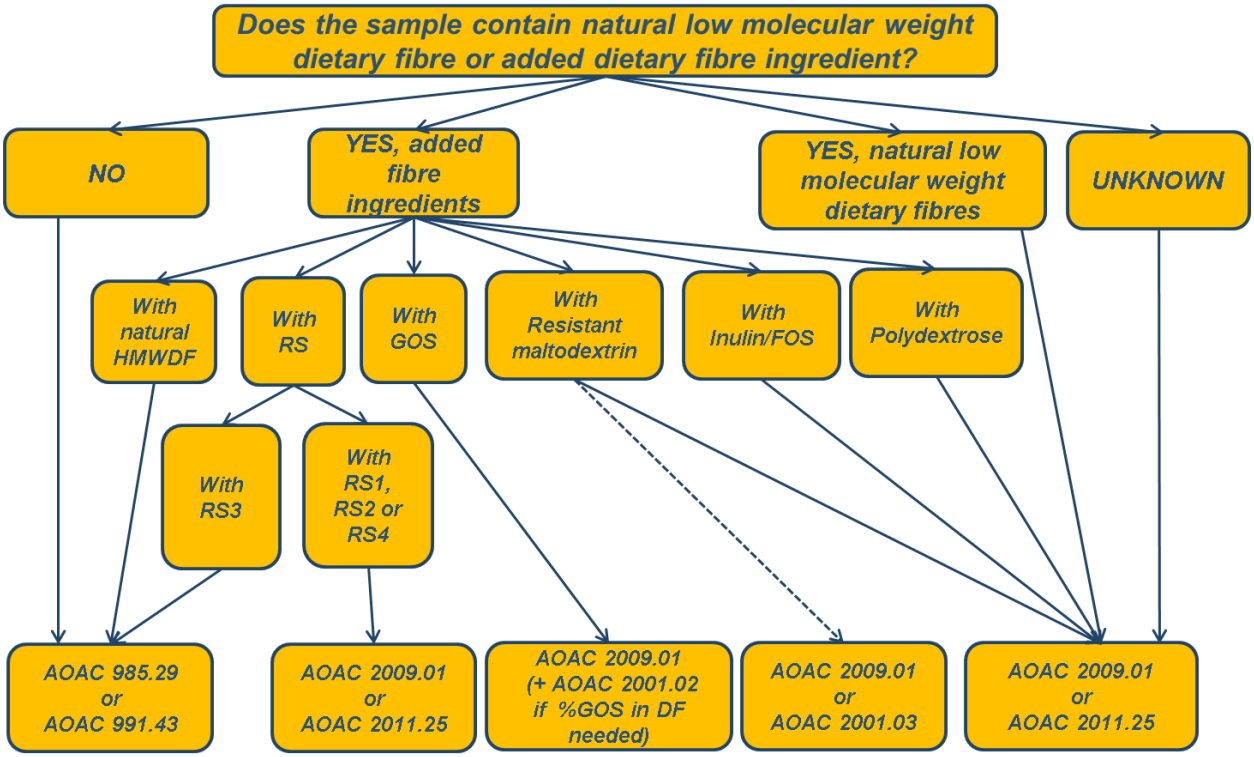
Eurofins has developed a decision tree that helps you in choosing the dietary fiber determination method that is most suited to your product. The decision tree is based on what is known about the dietary fiber ingredients used in the (food) product or material.

The AOAC 985.29 method can *sometimes* be used in order to obtain a "first result" always though under the condition that the product/sample does not contain any low molecular weight dietary fibre constituents.

Some products contain by nature low molecular weight dietary fibre as non-starch oligosaccharides and/or inulins. In case a mixture of different types of dietary fibers is present in a food sample, it is always advised to use AOAC 2009.01 (or AOAC 2011.25).

In agreement with the new (2008) definition of dietary fibre, in both the AOAC 2009.01 and the AOAC 2011.25 methods only the low molecular weight dietary fibre constituents of DP3 and higher are quantified. That means that, for example, in contrast to the dedicated AOAC 2001.02 GOS analyses, the

DP2 GOS constituents are not quantified when the above mentioned total dietary fibre methods are applied. The same is valid for di-fructose FOS constituents. These constituents will only be quantified by the dedicated AOAC 997.08 inulin/FOS method and not by the AOAC 2009.01 and AOAC 2011.25 total dietary fibre methods.



Scheme 4: Decision tree for selecting the best dietary fibre determination test.

Tests overview

Next to the above mentioned dietary fiber tests, the Eurofins Carbohydrate Competence Centre performs also several dedicated analyses for specific dietary fibre and/or prebiotic constituents: e.g. (branched) β-glucans from yeast, linear β-glucans from cereals (e.g. oats, barley), total resistant starch, and the different prebiotics such as inulin/FOS, galactooligosaccharides (GOS), polydextrose (PDX) and resistant maltodextrins. For most of these tests dedicated product information and technical brochures are available.

The following table summarizes a selection of the routinely performed dietary fiber tests as well as analyses for specific dietary fiber determination.

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Test code (matrix dependent)	Component	Matrix	Method source
HEC55*, HEC56, HEC63	Classical total (high molecular) dietary fibre	Solid and liquid food	AOAC 985.29
HEC1Q	Classical insoluble & soluble (high molecular) dietary fibre	Solid and liquid food	AOAC 991.43
HEC1A	Total dietary fibre, high molecular and low molecular weight	Solid and liquid food	AOAC 2009.01
HEC1B	Total dietary fibre , soluble & insoluble high molecular weight, low molecular weight	Solid and liquid food	AOAC 2011.25
HEC1F	Modified total dietary fibre, high molecular and low molecular weight	High starch containing food (e.g. bread, pasta, cookies)	Optimized AOAC 2009.01
HEC87	Resistant starch	Solid food	AOAC 2002.02
HEC3D*, HEC3E*	Inulin/FOS	Solid and liquid food	AOAC 999.03
HEC1G	Inulin/FOS	Ingredient/raw material	AOAC 997.08
HEC26, HEC1H, HEC1I	GOS	Solid and liquid food, ingredients & premixes	AOAC 2001.02
HEC38, HEC39	Polydextrose	Solid and liquid food	AOAC 2000.11
Contact us	Total dietary fibre for products fortified with res. maltodextrin	Food	AOAC 2001.03
HEC1C, HEC2Z	β-glucan (cereals)	Food	AOAC 995.16
HEC1J	β-glucan (yeasts)	Ingredients or products with >40% β-glucan content	In-house method

* Accredited test

Contact the Eurofins Carbohydrate Competence Centre or your local Eurofins office for

- Advice concerning the analytical methods for the dietary fibre characterization of your product
- Dedicated solutions for specific problems
- A complete portfolio of carbohydrates testing for raw materials, food, feed and products
- Fast and reliable determination of the different dietary fibres types
- A real energetic value and a declaration on your product
- Knowhow and close co-operation with certification bodies, leading food industries and technical Associations
- Trainings and courses on dietary fibers, carbohydrate chemistry, carbohydrate analysis, starches and a variety of related topics

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