DIETARY FIBER
What is Dietary Fiber and how do you select the appropriate method?

• **Explore**:  
  • Evolution: Definition of Dietary Fiber  
  • What Dietary Fiber means Today  
    • Methods of Analysis in AOAC  
  • Early, Interim and Current Testing Methodology  
    • The Main Methods  
  • How to Select Appropriate Testing  
    • Dietary Fiber at NQAC
"Dietary fiber consists of the remnants of edible plant cells, polysaccharides, lignin, and associated substances resistant to digestion by the alimentary enzymes of humans." Trowell

**1970’s**

Codex

Dietary fiber consists of carbohydrate polymers with ten or more monomeric units (DP>10), which are not hydrolyzed by the endogenous enzymes in the small intestines of humans.

**1985**

Codex

Dietary fibre means carbohydrate polymers* with ten or more monomeric units**, which are not hydrolysed by the endogenous enzymes in the small intestine of humans and belong to the following categories:

- Edible carbohydrate polymers naturally occurring in the food as consumed,
- Carbohydrate polymers, which have been obtained from food raw material by physical, enzymatic or chemical means and which have been shown to have a physiological effect of benefit to health as demonstrated by generally accepted scientific evidence to competent authorities,
- Synthetic carbohydrate polymers which have been shown to have a physiological effect of benefit to health as demonstrated by generally accepted scientific evidence to competent authorities.

*When derived from a plant origin, dietary fibre may include fractions of lignin and/or other compounds associated with polysaccharides in the plant cell walls. These compounds also may be measured by certain analytical method(s) for dietary fibre. However, such compounds are not included in the definition of dietary fibre if extracted and re-introduced into a food.

**Decision on whether to include carbohydrates from 3 to 9 monomeric units should be left to national authorities.
Today

Dietary fiber definition by FDA (Final Rule - Ref 21 CFR 101, 81 FR 33741; 05/27/2016):

Naturally occurring fibers that are intrinsic and intact in plants, and added isolated or synthetic non-digestible soluble and insoluble carbohydrates with beneficial physiological effects to human health, such as:

- lowering blood glucose and cholesterol levels,
- increasing feelings of fullness (satiety) resulting in reduced calorie intake,
- and improving bowel function.

Analytical methods cannot distinguish between non-digestible carbohydrates that do and do not meet the dietary fiber definition.

Therefore, firms must keep records for those foods that contain both dietary fibers that do meet the regulatory definition of dietary fiber along with added non-digestible carbohydrates that do not meet the definition of dietary fiber.

The amount of dietary fibers declared should represent the total fiber that is quantified by analytical methods minus the amount that does not meet the dietary fiber definition.
Nutrient or ingredient?

**Dietary Fiber is a nutritional property of Food.** It refers to the nutrients name not to a specific component, ingredient or specific analyte.

It may consist of:

- Naturally occurring edible carbohydrate polymers.
- Food Additives or Ingredients such as: Pectins, Carrageenan, Agar, Alginates, Guar gum, Cellulose, Beta-glucans, Resistant Starches RS 2 or RS 3, Polydextrose, Resistant Dextrin, Inulin, FOS, GOS, Psyllium, Wheat, Rye, Corn, Oat and Barley Fibers.
- A number of naturally occurring Fibers and some common Food Additives fall into CODEX Definition I – DP >10 or HMW Fiber.
- Most Fiber Ingredients fall into CODEX Definition II – DP >3 - DP <9 or LMW Fiber.
- FDA is preparing to define Fiber as DP > 3 and only include those ingredients shown to have beneficial effects to human health.
**A closer look…**

**Total Dietary Fiber** is composed of two forms: **Soluble** and **Insoluble** Fiber. Together they represent the **Total** fiber content in Foods.

**Soluble Fiber** dissolves in water to form a thick gel-like substance in the stomach. It is broken down by bacteria in the large intestine and provides some calories.

**Insoluble Fiber** does not dissolve in water and passes through the gastrointestinal tract relatively intact and, therefore, is not a source of calories. Depending on labelling requirements, individual Soluble and Insoluble Fiber determinations may be required.

**AOAC Methods are available to determine Soluble and Insoluble Fiber and LMW/HMW.**

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<table>
<thead>
<tr>
<th><strong>TDF</strong></th>
<th><strong>Insoluble HMW</strong></th>
<th><strong>Soluble HMW</strong></th>
<th><strong>Soluble LMW</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cellulose</td>
<td>(1→3),(1→4)-β-glucan</td>
<td>Polydextrose</td>
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<tr>
<td></td>
<td>Hemicellulose</td>
<td>Some Inulin</td>
<td>Some Inulin</td>
</tr>
<tr>
<td></td>
<td>Lignin*</td>
<td>Some Pectin</td>
<td>FOS / GOS</td>
</tr>
<tr>
<td></td>
<td>Some Pectin</td>
<td>LBG</td>
<td>Some Resistant</td>
</tr>
<tr>
<td></td>
<td>Etc.</td>
<td></td>
<td>Dextrin</td>
</tr>
</tbody>
</table>

* Although it is included in the current definition of TDF, Lignin is not a carbohydrate.

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In addition to soluble and insoluble, fibers are also defined by the degree of polymerization.

**High molecular weight (HMW)** is considered for molecules with >10 DP.

**Low molecular weight (LMW)** is considered for molecules with <10 DP.

Low molecular weight fibers consist mainly of soluble molecules.
### Methods of Analysis in AOAC

<table>
<thead>
<tr>
<th>Method Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>985.29</td>
<td>TDF (Prosky)</td>
</tr>
<tr>
<td>991.42</td>
<td>Insoluble Fibre</td>
</tr>
<tr>
<td>991.43</td>
<td>TDF, including soluble/insoluble</td>
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<tr>
<td>992.16</td>
<td>TDF</td>
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<tr>
<td>993.19</td>
<td>Soluble Fibre</td>
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<tr>
<td>993.21</td>
<td>TDF in products with &lt;2% starch and &gt;10% fibre</td>
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<tr>
<td>994.13</td>
<td>TDF (Uppsala)</td>
</tr>
<tr>
<td>997.08</td>
<td>Fructans</td>
</tr>
<tr>
<td>999.03</td>
<td>Fructans</td>
</tr>
<tr>
<td>2000.11</td>
<td>Polydextrose</td>
</tr>
<tr>
<td>2001.02</td>
<td>GOS</td>
</tr>
<tr>
<td>2001.03</td>
<td>TDF including resistant maltodextrin</td>
</tr>
<tr>
<td>2002.02</td>
<td>Resistant Starch</td>
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<tr>
<td>2009.01</td>
<td>TDF including low mw fibre (sometimes referred to as CODEX method)</td>
</tr>
<tr>
<td>2011.25</td>
<td>TDF including soluble/insoluble/low mw</td>
</tr>
</tbody>
</table>


**Early Testing Methodology**

References: AOAC 985.29 TDF, 991.43 TDF/ISF/SF

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**Interim Testing Methodology**

Introduction of LMW Fiber Ingredients

AOAC Methods evolved to quantify specific ingredients for GOS, FOS, Polydextrose and Resistant Starches. These methods use a variety of techniques to determine the LMW Fiber. The results from these determinations are often added to the HMW determination from above to report the Total Dietary Fiber.

References: AOAC 2001.02, AOAC 997.08 & AOAC 999.03, AOAC 2000.11, AOAC 2002.02 respectively.
Current Testing Methodology
Expanded Codex definition
References: AOAC 2009.01 TDF, AOAC 2011.25 TDF/ISF/SF

Quantitation of both HMW and LMW Fiber in a single analysis.
HMW determined by gravimetric measurement (early definition)
LMW determined by HPLC technology
# Main Methods Summary

<table>
<thead>
<tr>
<th>Method</th>
<th>TDF</th>
<th>Insoluble/Soluble Differentiation</th>
<th>Low MW Fibre Included</th>
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</thead>
<tbody>
<tr>
<td>985.29</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>991.43</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>2009.01</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>2011.25</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
Appropriate Method Selection
Labeling/Regulatory Requirement

HMW only (Codex Definition I)
- AOAC 985.29 – TDF
- AOAC 991.43 – TDF/ISF/SF

HMW and LMW (Codex Definition I)
- AOAC 2009.01 – TDF (codex)
- AOAC 2011.25 – TDF/ISF/SF
Ingredient Testing and Verification

- HMW only
  - AOAC 985.29 – TDF
  - AOAC 991.43 – TDF/ISF/SF
- HMW and LMW
  - AOAC 2001.03
  - Resistant Starches not present
  - AOAC 2009.01
  - TDF
  - AOAC 2011.25
  - TDF/ISF/SF
- LMW Ingredients
  - GOS
    - AOAC 2001.02
  - FOS
    - AOAC 997.08
    - AOAC 999.03
  - Polydextrose
    - AOAC 2000.11
  - Resistant Starch
    - AOAC 2002.02

Both HMW & LMW required

AOAC 2001.03
AOAC 997.08
AOAC 999.03
AOAC 2000.11
AOAC 2002.02
Previous method (till September 2016)
LI-00.546 based on AOAC -985.29

Current methods:
AOAC 991.43
AOAC 2009.01 – Codex method
AOAC 2011.25 – Codex method
Thank you.
Contact Customer Service with questions.
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