HEALTH EFFECTS OF CEREAL FIBRE
Cereal fibre consumption & potential impact on human health

Cereal fibre

Healthy lifestyle

WEIGHT MANAGEMENT

CHOLES-TEROL REDUCTION

GLYCAEMIC CONTROL

BOWEL FUNCTION

GUT BRAIN/LIVER AXIS AND IMMUNOSTIMULATION

Obesity

Cardiovascular diseases

Diabetes

Cancers

LIFE EXPECTANCY
Dietary fibre\(^1\) means carbohydrate polymers with 10 or more monomeric units\(^2\), 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 AND
- Carbohydrate polymers, which have been obtained from food raw material by physical, enzymatic or chemical means
- 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.

1) Dietary fibre may include fractions of lignin and/or other compounds when associated with polysaccharides in the plant cell walls (full text of definition: see explanation below)
2) Decision on whether to include carbohydrates from 3 to 9 monomeric units should be left to national authorities

Note: oligosaccharides DP 3 – 9 included by EU and many others e.g. Canada, China, Japan
Analysis of dietary fibre

Integrated Procedure: AOAC Method 2009.01
Measuring all fibres included in Codex definition

Galacto-oligosaccharides (AOAC method 2001.03)
Raffinose/Stachyose

POLYDEXTROSE (AOAC METHOD 2000.11)
FIBRESOL 2 (AOAC METHOD 2001.03)

ASSOCIATED COMPONENTS

“Total” Dietary Fibre (AOAC Method 985.29)
(AOAC Method 991.43)

INULIN/FOS (AOAC METHODS 997.08 AND 999.03)

RESISTANT STARCH (AOAC METHOD 2002.02)

Pectin Arabinogalactan

Cellulose Beta-Glucan
Galactomannan
Arabinoxylan

McCleary, 2007
Cereal fibre in the Codex-classification system

Codex definition of fibre

Fibre naturally occurring in foods

Synthesized fibre

Isolated fibre

From grain kernels:
- Soluble arabinoxylan from wheat endosperm
- Resistant maltodextrin from wheat
- Resistant starch from maize

From straw, or husks:
- Cellulosic fibres

Isolated fibre purified, (often) without co-passengers
Other classification systems

Dietary fibre

Soluble dietary fibre (SDF)

Insoluble dietary fibre (IDF)

AOAC Method 991.43 measures SDF and IDF separately

Dietary fibre

Fermentable

Non-fermentable

Recommended by FAO
### Fibre in cereals and location of bioactive compounds

<table>
<thead>
<tr>
<th>Cereal</th>
<th>DF (g/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheats</td>
<td>12</td>
</tr>
<tr>
<td>Oats</td>
<td>11</td>
</tr>
<tr>
<td>Barley</td>
<td>16</td>
</tr>
<tr>
<td>Maize</td>
<td>7</td>
</tr>
<tr>
<td>Rye</td>
<td>15</td>
</tr>
<tr>
<td>Rice</td>
<td>4</td>
</tr>
<tr>
<td>Millet</td>
<td>9</td>
</tr>
<tr>
<td>Sorghum</td>
<td>6</td>
</tr>
<tr>
<td>Teff</td>
<td>8</td>
</tr>
<tr>
<td>Pseudo Cereal</td>
<td></td>
</tr>
<tr>
<td>Wild rice</td>
<td>6</td>
</tr>
<tr>
<td>Amaranth</td>
<td>7</td>
</tr>
<tr>
<td>Buckwheat</td>
<td>10</td>
</tr>
<tr>
<td>Quinoa</td>
<td>7</td>
</tr>
</tbody>
</table>


The wheat grain kernel and its components:


### Dietary fibre content in different cereal fractions (g/100g DM)

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Wheat</th>
<th>Oats</th>
<th>Rye</th>
<th>Rice</th>
<th>Maize</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole grain</td>
<td>12</td>
<td>11</td>
<td>15</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Bran</td>
<td>43</td>
<td>15</td>
<td>44 #</td>
<td>21</td>
<td>79</td>
</tr>
<tr>
<td>Starchy endosperm</td>
<td>2.7</td>
<td>6.5</td>
<td>8</td>
<td>2</td>
<td>1.9</td>
</tr>
<tr>
<td>Germ</td>
<td>13</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Free and bound phytochemicals associated with fibre

Hydrocinnamic acids such as ferulic, p-comaric and sinapic acids and their dimers are present to greater extent in cereals (mainly bound) than in fruits and vegetables. (Neacsu et al. (2013) Food Chemistry)

<table>
<thead>
<tr>
<th>Compound</th>
<th>Wheat (µg/100g)</th>
<th>Rye (µg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tocols</td>
<td>28-80</td>
<td>44-67</td>
</tr>
<tr>
<td>Phenolic acids (90-95% bound)</td>
<td>326-1171</td>
<td>491-1082</td>
</tr>
<tr>
<td>Plant sterols</td>
<td>670-960</td>
<td>1098-1420</td>
</tr>
<tr>
<td>Alkylresorcinols</td>
<td>241-677</td>
<td>797-1231</td>
</tr>
<tr>
<td>Lignans</td>
<td>3.4-23</td>
<td>25-67</td>
</tr>
<tr>
<td>Benzoxazinoids</td>
<td>4.8</td>
<td>95</td>
</tr>
</tbody>
</table>
Differences in the contribution of fibre from grain fractions to Guidelines Daily Amounts (GDA)

GDA (25 g total fibre per day)

Intake of 100 g

- Oat bran
- Sifted rye flour
- Sifted oats
- Whole grain rye
- Sifted rye
- Whole grain wheat
- Rye bran
- Sifted rye flour
- Whole grain wheat
- Rye bran
- Sifted rye flour
- Whole grain wheat
- Rye bran

% of GDA

Source: National Nutrient Database for Standard Reference (Release 24), ARS, USDA
Overweight – a growing European problem

Percentage of males overweight (BMI ≥25) 2010

Source: WHO Global Database on Body Mass Index 2010
Obesity
– a major risk factor of diabetes, cardiovascular disease and maybe cancer

Percentage of males obese
(BMI ≥30) 2010

Source: WHO Global Database on Body Mass Index 2010
Diabetes
– growing national prevalence

The main cause of death in the EU is Cardiovascular disease (CVD)

Death by cause, WOMEN

- Coronary heart disease (CHD) and stroke are the main forms of CVD
- CVD causes 47% of all deaths in Europe and 40% in EU
The main cause of death in the EU is Cardiovascular disease (CVD)

- Coronary heart disease (CHD) and stroke are the main forms of CVD
- CVD causes 47% of all deaths in Europe and 40% in EU
Colorectal cancer is the second most common cause of cancer death in both men and women!
Health effects of cereal fibre

**Current status on cereal fibre and health effects**

- EU approved health claims
- Official recommendations by Nutritional Societies
- Results from systematic reviews and meta-analyses

- Type 2 Diabetes (T2D)
- Cardiovascular disease (CVD)
- Colorectal cancer (CRC)

- Official recommendations by Nutritional Societies
- Results from systematic reviews and meta-analyses

- Type 2 Diabetes (T2D)
- Cardiovascular disease (CVD)
- Colorectal cancer (CRC)
Nutrition claims for fibre (including cereal fibre): EU and other regulations:

Nutritional statements on products in Europe are regulated in

**REGULATION (EC) No 1924/2006** on nutrition and health claims made on foods – Annex 1

**SOURCE OF FIBRE:** Foods with at least 3g fibre/100g or 1.5g/100 kcal

**HIGH FIBRE** Foods with at least 6g fibre/100g or 3g/100 kcal

**INCREASED FIBRE** Foods being at least a source of fibre and with at least 30% more fibre than a similar product

CODEX recommendations for **Source of** and **High** list as additional option 10% and 20% of daily reference value per serving.
## EU authorized Health Claims on Cereal Fibre - Laxation

<table>
<thead>
<tr>
<th>Material</th>
<th>Health claim</th>
<th>Conditions of use</th>
<th>EFSA opinion reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rye fibre</td>
<td>Normal bowel function</td>
<td>Foods should be high in that fibre (i.e. fibre ≥ 6g/100g product) and daily intake ≥ 10g is required</td>
<td>2011;9(6):2258</td>
</tr>
<tr>
<td>Barley grain fibre</td>
<td>Increase in faecal bulk</td>
<td></td>
<td>2011;9(6):2249</td>
</tr>
<tr>
<td>Oat grain fibre</td>
<td>Increase in faecal bulk</td>
<td></td>
<td>2011;9(6):2249</td>
</tr>
<tr>
<td>Wheat bran fibre</td>
<td>Increase in faecal bulk</td>
<td></td>
<td>2010;8(10):1817</td>
</tr>
<tr>
<td>Wheat bran fibre</td>
<td>Accelerated intestinal transit</td>
<td>Foods should be high in that fibre and daily intake ≥ 10g is required</td>
<td>2010;8(10):1817</td>
</tr>
</tbody>
</table>
EU authorised Health Claims on Cereal Fibre and Cholesterol levels

<table>
<thead>
<tr>
<th>Material</th>
<th>Health claim</th>
<th>Conditions of use</th>
<th>EFSA opinion reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>β-glucans (Bg)</td>
<td>Maintenance of normal cholesterol levels (Article 13.1 claim)</td>
<td>Daily intake of 3 g required&lt;br&gt;Food with ≥ 1 g of Bg per quantified portion.</td>
<td>2009;7(9):1254, 2011;9(6):2207</td>
</tr>
<tr>
<td>Oat β-glucan</td>
<td>Oat (respectively barley) beta-glucan has been shown to lower/reduce blood cholesterol. High cholesterol is a risk factor in the development of coronary heart disease Article 14.(1)(a) claim (disease reduction claim)</td>
<td>Daily intake of 3 g required&lt;br&gt;Foods which provide at least 1g of oat (respectively barley) per portion</td>
<td>Q-2008-681&lt;br&gt;Q-2011-00798 and Q-2011-00799</td>
</tr>
<tr>
<td>Material</td>
<td>Health claim</td>
<td>Conditions of use</td>
<td>EFSA Opinion Reference</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>----------------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Arabinoxylan produced from wheat endosperm</td>
<td>Reduction of blood glucose rise after a meal</td>
<td>Daily intake ≥ 8g AX rich fibre</td>
<td>2011;9(6):2205</td>
</tr>
<tr>
<td>β-glucans from oats and barley</td>
<td></td>
<td>Intake ≥ 4g / 30g digestible carbs</td>
<td>2011;9(6):2207</td>
</tr>
<tr>
<td>Resistant starch (RS)</td>
<td></td>
<td>RS Content ≥ 14% of total starch</td>
<td>2011;9(4):2024</td>
</tr>
</tbody>
</table>
Scientific Statements of Cereal Fibre and Disease

Consumption of cereal fiber, mixtures of whole grains and bran, and whole grains and risk reduction in type 2 diabetes, obesity, and cardiovascular disease\(^1\)\(^-\)\(^4\)

Susan S Cho,\(^5\) Lu Qi,\(^6\) George C Fahey Jr,\(^7\) and David M Klurfeld\(^8\)*

**Evidence level: A (strong evidence)- D (inadequate evidence)**

<table>
<thead>
<tr>
<th></th>
<th>T2D</th>
<th>Obesity</th>
<th>CVD</th>
<th>Hypertension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereal Fibre</td>
<td>B</td>
<td>B/C</td>
<td>B</td>
<td>D</td>
</tr>
<tr>
<td>Mixtures of whole grains and bran</td>
<td>B</td>
<td>B/C</td>
<td>B</td>
<td>D</td>
</tr>
<tr>
<td>Whole grains</td>
<td>C</td>
<td>C/D</td>
<td>C</td>
<td>D</td>
</tr>
</tbody>
</table>

- **The ASN position:** Consumption of foods rich in cereal fibre or mixtures of whole grains and bran is modestly associated with a reduced risk of *obesity* (B/C), T2D (B), and CVD (B).
- Statement based on current available literature from 1965-2010.
- No long-term RCTs (>1y) using cereal fibre was available for *disease endpoint.*

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**Cho et al. Am J Clin Nutr (2103)**
High intake of cereal fibre or whole grain products is associated with a lower risk of type 2 diabetes mellitus, hypertension and coronary heart disease.

Less strong evidence for overweight/obesity compared to CVD and T2D. More research is needed.

High intake of cereal fibre is associated with lower risk of developing colorectal cancer.
# German Nutrition Society – Summary of Evidence

<table>
<thead>
<tr>
<th></th>
<th>T2D</th>
<th>CHD</th>
<th>Stomach cancer</th>
<th>Colon cancer</th>
<th>Obesity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total dietary fibre (DF)</td>
<td>O</td>
<td>↓↓</td>
<td>~</td>
<td>↓</td>
<td>↓↓</td>
</tr>
<tr>
<td>DF from cereal products</td>
<td>↓↓</td>
<td>↓</td>
<td>↓</td>
<td>↓↓</td>
<td>–</td>
</tr>
<tr>
<td>Wholegrain products</td>
<td>↓↓</td>
<td>↓↓</td>
<td>–</td>
<td>–</td>
<td>↓</td>
</tr>
</tbody>
</table>

**Legend**

- not assessed
- possible evidence, no association
- possible evidence, risk reducing
- probable evidence, risk reducing
- insufficient evidence

Whole grain, dietary fibre, and disease - review

Greater Whole-Grain Intake Is Associated with Lower Risk of Type 2 Diabetes, Cardiovascular Disease, and Weight Gain¹⁻³

Eva Qing Ye,⁴⁻⁶,⁹ Sara A. Chacko,⁴⁻⁶,⁹ Elizabeth L. Chou,⁴⁻⁶ Matthew Kugizaki,⁸ and Simin Liu⁴⁻⁷⁺

- Review and meta-analysis of 45 prospective cohorts and 21 randomized intervention trials indicates that increased intake of whole grain and fibre may lower the risk of T2D, CVD, and weight gain.

- Highest vs lowest cereal fibre intake was associated with a 16% and 19% lower risk of developing T2D and CVD, respectively.

- Long-term RCTs seem warranted to elucidate mechanisms underlying the potential beneficial effects for the prevention of chronic diseases.

Dietary Fibre and CVD
Dietary fibre intake and risk of cardiovascular disease: systematic review and meta-analysis

Diane E Threapleton doctoral student¹, Darren C Greenwood senior lecturer in biostatistics², Charlotte E L Evans lecturer in nutritional epidemiology¹, Christine L Cleighorn research fellow¹, Camilla Nykjær research assistant¹, Charlotte Woodhead research assistant¹, Janet E Cade professor of nutritional epidemiology group¹, Christopher P Gale associate professor of cardiovascular health sciences ², Victoria J Burley senior lecturer in nutritional epidemiology¹

<table>
<thead>
<tr>
<th>Outcome and exposure</th>
<th>No of studies</th>
<th>$i^2$ (%)</th>
<th>Risk ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cardiovascular disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total fibre (per 7 g/day)</td>
<td>10</td>
<td>45</td>
<td>0.91 (0.88 to 0.94)</td>
</tr>
<tr>
<td>Soluble fibre (per 4 g/day)</td>
<td>4</td>
<td>58</td>
<td>0.88 (0.75 to 1.03)</td>
</tr>
<tr>
<td>Insoluble fibre (per 7 g/day)</td>
<td>3</td>
<td>46</td>
<td>0.82 (0.70 to 0.96)</td>
</tr>
<tr>
<td>Fibre in cereals (per 7 g/day)</td>
<td>5</td>
<td>15</td>
<td>0.92 (0.84 to 1.00)</td>
</tr>
<tr>
<td>Fibre in fruit (per 4 g/day)</td>
<td>4</td>
<td>0</td>
<td>0.96 (0.93 to 1.00)</td>
</tr>
<tr>
<td>Fibre in vegetables (per 4 g/day)</td>
<td>4</td>
<td>0</td>
<td>0.92 (0.87 to 0.96)</td>
</tr>
<tr>
<td>Coronary heart disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total fibre (per 7 g/day)</td>
<td>12</td>
<td>33</td>
<td>0.91 (0.87 to 0.94)</td>
</tr>
<tr>
<td>Soluble fibre (per 4 g/day)</td>
<td>6</td>
<td>47</td>
<td>0.89 (0.78 to 1.02)</td>
</tr>
<tr>
<td>Insoluble fibre (per 7 g/day)</td>
<td>5</td>
<td>72</td>
<td>0.82 (0.68 to 0.99)</td>
</tr>
<tr>
<td>Fibre in cereals (per 7 g/day)</td>
<td>9</td>
<td>65</td>
<td>0.84 (0.76 to 0.94)</td>
</tr>
<tr>
<td>Fibre in fruit (per 4 g/day)</td>
<td>9</td>
<td>62</td>
<td>0.92 (0.83 to 1.01)</td>
</tr>
<tr>
<td>Fibre in vegetables (per 4 g/day)</td>
<td>9</td>
<td>0</td>
<td>0.94 (0.89 to 1.00)</td>
</tr>
</tbody>
</table>
Total DF is associated with lower risk of stroke (RR decreased with 17% per 7g/d).

Studies differ considerably.

Separate investigation of fibre from different sources warranted!
Dietary fibre, whole grains, and risk of colorectal cancer: systematic review and dose-response meta-analysis of prospective studies

A high intake of dietary fibre, in particular from cereals, is associated with a reduced risk of colorectal cancer

Similar results from EPIC as shown by Aune et al.
Dietary fibre and breast cancer risk: a systematic review and meta-analysis of prospective studies

D. Aune¹*, D. S. M. Chan¹, D. C. Greenwood², A. R. Vieira¹, D. A. Navarro Rosenblatt¹, R. Vieira¹ & T. Norat¹

¹Department of Epidemiology and Biostatistics, School of Public Health, Imperial College, London; ²Biostatistics Unit, Centre for Epidemiology and Biostatistics, University of Leeds, Leeds, UK

Received 4 October 2011; revised 18 November 2011; accepted 21 November 2011

- Total dietary fibre was associated with lower risk of breast cancer (relative risk reduction of reduction of 15% per 10g/d, n=16 prospective studies)
- Further studies of specific types of fibre should be undertaken
Fibre from different sources and mortality in Europeans

Hazard risk (HRs) and 95% confidence interval (CI) of total death and cause-specific deaths per 5-g/d increase in fiber intake in men (A) and women (B)


High fibre intake, mainly from cereals and vegetables, may reduce the risk of death from circulatory, digestive and non-CVD non-cancer inflammatory diseases.
Effect of dietary fiber on constipation: A meta analysis

Jing Yang, Hai-Peng Wang, Li Zhou, Chun-Fang Xu (2012), World J Gastroenterol

- Dietary fibre showed significant advantage over placebo in stool frequency (19%, P<0.05)
- No difference in stool consistency, treatment success, laxative use and painful defecation compared to control

![Bar chart showing regularity promotion for different types of fiber](chart.png)


*This chart shows the ability of different types of fiber to promote regularity compared to wheat bran fiber*
Cereal fibre and weight management - results from observational studies and RCTs

Observational studies:

Epidemiological studies have shown inverse associations between cereal fiber intake and BMI, weight gain and body fat  

Randomized controlled trails:

Whole grain and body weight changes in apparently healthy adults: a systematic review and meta-analysis of randomized controlled studies

Health effects of dietary fibre – suggested mechanisms

Dietary fibre complex

Fermentable CHO
- Colonic fermentation (SCFA)
- GI and/or IL
- Insulin sensitivity
- Blood pressure
- Blood lipids
- Body weight
- Cancers
- Type 2 Diabetes
- CVD
- Mortality

Non-fermentable CHO
- homocysteine
- Oxidation/inflammation
- Tumour growth

Phytochemicals

Effect on intermediate endpoint
Effect on hard endpoint
Cereal fibre and effects on:

- **Immune system**
  - Role of prebiotics in inflammatory bowel disease (J Biol Regul Homeost Agents 2013;27(4):919-33.)

- **Mental function**
  - Effects on memory (episodic, semantic, and working memory), language, attention, executive function, and information processing speed (Nutr Rev. 2014 Mar;72(3):162-79)

- **”Gut-brain &/or- liver” axis**
  Influence of the microbial-mammalian metabolic axis with implication for energy metabolism, appetite and cognitive functions. Effects of cereal fibre fermentation products such as SCFA on host health
### Recommended dietary fibre consumption across the world

<table>
<thead>
<tr>
<th></th>
<th>Intake/day</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFSA (2010)</td>
<td>25 g</td>
<td>25 g is adequate for normal laxation in adults. Diets rich in fibre containing foods at DF intakes ≥ 25g are associated with additional health benefits</td>
</tr>
<tr>
<td>WHO (2003)</td>
<td>≥ 25g</td>
<td>Total dietary fibre from whole grain cereals, fruit and vegetables</td>
</tr>
<tr>
<td>Germany, Austria, Switzerland (D-A-CH,2008)</td>
<td>≥ 30g</td>
<td>At least 30 grams of dietary fibre daily, especially from whole-grain products</td>
</tr>
<tr>
<td>Netherlands (GR, 2001, 2006)</td>
<td>30-40g</td>
<td>30-40 g dietary fibre via products not enriched with isolated and purified dietary fibre</td>
</tr>
<tr>
<td>Nordic Countries (NNR 2012)</td>
<td>25-35g</td>
<td></td>
</tr>
<tr>
<td>USA (IoM, 2005)</td>
<td>25-38g</td>
<td>Total fibre from whole grain cereals, fruit and vegetables for women and men, respectively</td>
</tr>
<tr>
<td>USA (USDA, 2010)</td>
<td></td>
<td>Consuming enough whole grains helps meet nutrient needs. Choosing whole grains that are higher in dietary fibre has additional health benefits</td>
</tr>
<tr>
<td>UK (DoH, 1991)</td>
<td>18 g (NSP)</td>
<td>18 g non-starch polysaccharides</td>
</tr>
</tbody>
</table>
Examples of foods high in cereal fibre
Concluding remarks

- Dietary fibre is defined world-wide

- Whole grains, especially from wheat, rye, oats and barley, and bran products are good sources of dietary fibre (cereal fibre)

- High cereal fibre intake is associated with a reduced risk of obesity, T2D, CVD and colorectal cancer

- β-glucans (>3g/d) from oats and barley reduce cholesterol and improves glycaemic response after a meal (>4g per 30g CHO)

- Among the dietary fibre sources, cereal fibre show stronger beneficial associations with non-communicable diseases

- Many different mechanisms have been suggested for attributing protective effects to properties of fibre such as solubility, viscosity, fermentability and associated bioactive compounds.
The HEALTHGRAIN EU Integrated Project (2005-2010) - the largest cereal project ever – has substantially strengthened the scientific basis for a new generation of cereal products with enhanced health benefits.

The Healthgrain Forum ([www.healthgrain.org](http://www.healthgrain.org)) has been initiated in 2010 for continuing HEALTHGRAIN’s research, networking and communication activities. Currently (status October 2014) 54 member organisations joined, with an even balance between academia, research organisations, industry and members focusing on communication on grains and health.

The Healthgrain Forum will evaluate and update this presentation annually. For questions and suggestions please contact:

jan-willem.vanderkamp@tno.nl
ANNEX

Content
- Fibre analysis – comparison of old and new AOAC Methods
- EU Health Claims on Fibre and Cereal Fibre
Fibre measured with AOAC Methods 985.29 (‘old’) and 2009.01 (‘new’)
Data from Brunt and Sanders, Food Chemistry 140 (2013) 574-580

**Table 2**
Comparison of the total dietary fibre content as measured with the classical AOAC 985.29 (triplicate average and standard deviation) and the new AOAC 2009.01 (triplicate average and standard deviation) method and the dietary fibre data as listed in the Dutch nutrition tables (NEVO nutrition tables).

<table>
<thead>
<tr>
<th>Type of bread</th>
<th>NEVO (Dutch)</th>
<th>AOAC 985.29</th>
<th>AOAC 2009.01</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>According NEVO nutrition tables</td>
<td>Total</td>
<td>HMWDF</td>
</tr>
<tr>
<td>White bread</td>
<td>2.5</td>
<td>3.0 ± 0.1</td>
<td>3.0 ± 0.1</td>
</tr>
<tr>
<td>Wheat bread</td>
<td>6.0</td>
<td>5.0 ± 0.1</td>
<td>5.2 ± 0.1</td>
</tr>
<tr>
<td>Wholemeal bread</td>
<td>6.6</td>
<td>7.5 ± 0.5</td>
<td>7.7 ± 0.1</td>
</tr>
<tr>
<td>More grains bread</td>
<td>7.3</td>
<td>7.6 ± 0.4</td>
<td>7.3 ± 0.1</td>
</tr>
<tr>
<td>Currant loaf</td>
<td>3.2</td>
<td>3.2 ± 0.1</td>
<td>3.5 ± 0.1</td>
</tr>
</tbody>
</table>

**Table 3**
Comparison of the established total dietary fibre content measured with the classical AOAC 985.29 and with the new AOAC 2009.01 total dietary fibre analysis method.

<table>
<thead>
<tr>
<th>Sample</th>
<th>AOAC 985.29</th>
<th>AOAC 2009.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>Total</td>
<td>HMWDF</td>
</tr>
<tr>
<td>Bread</td>
<td>4.5</td>
<td>5.1</td>
</tr>
<tr>
<td>Crude pasta</td>
<td>6.7</td>
<td>6.5</td>
</tr>
<tr>
<td>Cooked pasta</td>
<td>n.m.</td>
<td>3.9</td>
</tr>
<tr>
<td>Wheat flour</td>
<td>2.4</td>
<td>3.4</td>
</tr>
<tr>
<td>Wheat grain</td>
<td>12.8</td>
<td>12.4</td>
</tr>
<tr>
<td>Wheat middlings</td>
<td>46.6</td>
<td>45.6</td>
</tr>
</tbody>
</table>

n.m. = not measured.
EU Health Claims on fibre and cereal fibre

After adoption of Regulation (EC) 1924/2006:
- Submission of many thousands health claims for evaluation
- In depth evaluation by EFSA of 2245 eligible claims
- Authorisation by EU of 250 health claims

Overview of all 2245 claims: [http://ec.europa.eu/nuhclaims](http://ec.europa.eu/nuhclaims)

Examples of non-authorised health claims:

<table>
<thead>
<tr>
<th>Material</th>
<th>Health claims</th>
<th>Non authorised, reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dietary fibre</td>
<td>Various claims, including - laxation/ bowel function - Reduction of blood glucose rise after a meal - Maintenance of normal cholesterol levels</td>
<td>insufficiently characterised</td>
</tr>
<tr>
<td>Soluble fibre</td>
<td></td>
<td>insufficiently characterised</td>
</tr>
<tr>
<td>Resistant wheat dextrins</td>
<td></td>
<td>Evidence is insufficient</td>
</tr>
</tbody>
</table>