Texas Academy of Nutrition and Dietetics

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Dietary Fiber is an Essential Nutrient and Still Severely Lacking in the Diet. Why?

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Dennis T. Gordon
Scientific Interests

Track the components of any ingested food or food stuff resulting from digestion in the small intestine (i.e., sugars, fatty acids, amino acids, essential nutrients, and nutraceuticals) and fermentation in the large intestine (i.e., short chain fatty acids, metabolites, and unknowns) and absorption and functionality in the body (e.g., bioavailability).
Conflicts of Interests/Work

Retired from academia in Dec 31, 2013. Since then, I have been continuously employed by many private companies (nationally and internationally) to help answers their questions.

Only give four nutrition lectures-My Signature

I am not selling any product, but promoting an idea/concept/hypothesis (**increase DF consumption** – **recognize its importance**).
Disclosures

1. Matsutani, Chemical Industry Co, Ltd. Osaka, Japan

2. ADM/Matsutani, LLC. | Matsutani America, Inc. Decatur & Itasca, Illinois

3. Lallemand /American Yeast Montreal Canada

4. Others
Dietary Fiber: Stayed Focused

- An extreme complex mixture of non-digestible carbohydrates in a huge variety of mainly plant-based foods.
- There is no way to separate, identify the sources and complexity of DF in foods, on the Food Label.
- My opinion: our human body does not differentiate the combined benefits of the ingested complex termed dietary fiber.
Dietary Fiber in Perspective

- Stayed focused on dietary fiber (DF). Focus on DF, separate from all nutrients and other possible health promoting ingredients (nutraceuticals).

- Only one term “Dietary Fiber” on the food label.
Key Words; A Changing Society; Focus only on Dietary Fiber

Dietary fiber (DF), Nutrient/Essential Nutrient, Intestine, Laxation, Microbiota-Microbiome, Fermentation, DF Requirements, Beneficial Physiological Effects for Health, Insoluble & Soluble DF, Glycemic Index/Load, Metabolic Syndrome (i.e., CHD, Type 2, HT) Prebiotics, Probiotics, Adequate Intake (AI), Food Label-Nutrition Facts, Added Fiber/Functional Fiber, Healthy, Normal, Healthy, Wellness, FODMAP, Functional Foods, Nutraceuticals, Natural, No- GMO, Clean Labels, Health Claims, Structure Function Claims, etc, etc, etc
Professional Organizations and the Consumer

**AACC**I: Create and provide opportunities to exchange knowledge in cereal/grain science

**AND**: Empowering members to be food and nutrition leaders

**ASN**: To develop and extend knowledge of nutrition of all species through fundamental, multidisciplinary, and clinical research

**IFT**: To advance the science of food and its application across the global food system.
Questions for you; with answers

1. What is the biggest nutrition/health issue?
2. What is, what does, DF do?
3. Is DF as essential nutrient?
4. How does DF help to optimize health through food and nutrition?
5. Are “added fibers” physiologically equivalent to DF in plant foods?
6. What are the consequences of inadequate DF? Excess?
7. What is a recommended intake for DF?
Weight

BMI

< 25  25 - 30  > 30
Normal  Overweight  Obese

Where/how does DF benefit these BMI states?
Introductory Remarks

- Making a living
- Normal presentation program; Q & A
- Embarrassment vs Confidence
The Present & Future of Nutrition and Health

My Mantra/Signature

- Exercise ★★★
- Moderation ★★★
- Variety ★★★ (of dietary & functional foods)
- Manage stress ★★★
Summary

Eat more dietary fiber

(Problem: where will it come from in your diet?)
Objectives

- Looking for uniformity of an essential nutrient “Dietary Fiber”
- Singularity of the term “Dietary Fiber” (One term on Food Label)
- Common/Unifying essential effects beyond “beneficial physiological effects for human health”
- Establish DF essentiality (Justify)

Increase DF Intake
Summary

1. DF must be supplied in the diet, but is ubiquitous in the diet.

2. DF is essential in preventing constipation, diverticular disease, colon polyps, hemorrhoids, and aspects of IBS or functional bowel disorders.

3. The quintessential properties of DF are its ability to promote "laxation" and provide the primary energy source for microbiota growth.
4. Laxation is more than peristalsis and decreased fecal transit times and more frequent bowel movements.

5. Laxation is the complete physiological and biochemical process of the intestine and colon functioning normally.

6. The maturation, function and regeneration of the intestine and all its specialize cells can only occur in the presence of DF.
7. The microbiota are an essential part of intestinal function, they produce essential SCFA, and collectively and synergistically the microbiota and SCFA facilitate and promote the body immune system, innate and acquired.

8. DF as consumed and reported on Food Labels is recognized by the intestine as a single essential nutrient.

9. A diet providing 25-50 g DF/day would be beneficial for optimal fecal mass and laxation.
Dietary Fiber’s Quintessential Cycle

The essential primer

Dietary Fiber

Immune System

Fermentation
SCFA, Energy & Metabolites

Intestinal Cell Development & Function (Laxation)
Key Topics

- Dietary Fiber
- Essentaility
- Intestinal development, morphology and cellular function; plus animal studies
- Microbiota and diet-DF, distribution and total
- Fermentation, SCFA and .....
- Immunity
- Additional (indirect) observations supporting DF essentiality (5 points)
- Laxation
Dietary Fiber – Brief History

- Prior to 1960s - roughage
- 1960’s DF Hypothesis
- 1990 Nutrition Labeling and Education Act
  - Declared a statuary nutrient; DV 25g/day
  - Method of analysis became/is de facto definition
- 2005 -- IOM set AIs; 38g/d M & 25 g/d F
Dietary Fiber is Complex

An under statement

- Wheat Bran; classic insoluble bulking
- Insoluble
  - Cellulose, Hemicellulloses, Resistant Starch
- Soluble, precipitate in alcohol
  - Pectins, Gums, Mucilages
- Viscous; β-glucans
- Non-digestible oligosaccharides; inulin, FOS, GOS, RMD
- All partially or totally fermented
Claimed Prebiotics
Dietary Fiber Methodology

de facto definition of Dietary Fiber

AOAC Approved Methods > 20

Gravimetric Procedure
  Insoluble DF, residue
  Soluble DF, precipitated with alcohol

Liquid Chromatography
  Soluble Oligosaccharides (DP 3 – 10-13)
Dietary Fiber consists of non-digestible carbohydrates and lignin that are intrinsic and intact in plants.

Functional Fiber – Added Fiber consists of isolated, non-digestible carbohydrates that have beneficial physiological effects in humans.

Total Fiber is the sum of Dietary Fiber and Functional Fiber.

1Dietary Reference Intakes….(Macronutrients) Natl Acad Press, 2005
Beneficial Physiological Effects of Added Fiber For Human Health

- Total and LDL cholesterol attenuation
- Post-prandial glucose & insulin attenuation
- Blood pressure decrease
- Increased fecal bulk (microbiota) and laxation
- Transit time, decreased
- Colonic fermentation, SCFA & others
- Modulation of microbiota and microbiome
- Weight loss, weight maintenance, and reduction in adiposity
- Increased satiety

1FDA Requirement
2Do these effects make DF essential or just beneficial?
Current and Proposed Food Label

The consumer/scientist sees only one value for dietary fiber to make a decision.
Current and Proposed Food Label

There is no Official AOAC Dietary Fiber Method of Analysis (i.e., 20) or any analytical method, nor can the intestinal track tell the difference between dietary fiber and added fiber.
DTG and FDA Proposed Food Label

Nutrition Facts
8 servings per container
2/3 cup (55g)

Calories/Serving
230

%DV
12% Total Fat 8 g
5% Saturated Fat 0 g
7% Sodium 160 mg
12% Total Carbs 37 g
14% Dietary Fiber 4 g
Sugar 1 g
Added Sugar 0 g
Protein 3 g

Amount per 2/3 cup

Calories 230

% DV*
12% Total Fat 8 g
5% Saturated Fat 1 g
Trans Fat 0 g
0% Cholesterol 0 mg
7% Sodium 160 mg
12% Total Carbs 37 g
14% Dietary Fiber 4 g
Sugars 1 g
Added Sugars 0 g
Protein 3 g

* Footnote on Daily Values (DV) and calories reference to be inserted here.
Dietary Fiber

With many different forms and sources of non-digestible carbohydrates (NDC) in foods and added to foods, and with their different chemical and physical properties, they play an **essential role** in intestinal morphology and function and serve as the primary energy source for the microbiota. **Sweet music!**
### Average Dietary Fiber Intakes

#### Added Dietary Fiber in Foods

<table>
<thead>
<tr>
<th></th>
<th>Average g / day</th>
<th>Low g / day</th>
<th>High g / day</th>
<th>AI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>18</td>
<td>9</td>
<td>35</td>
<td>38 &lt; 3%</td>
</tr>
<tr>
<td>Females</td>
<td>14</td>
<td>6</td>
<td>23</td>
<td>25 &lt; 3%</td>
</tr>
</tbody>
</table>

There are in an excess of 500 new food products introduced each year with added fiber.
Functional Foods: 9- Classes of Nutraceuticals (not essential yet)

- Additives, sugar & fat substitutes > 100
- Botanicals, > 100
- Carbohydrates, > 1,000 plus, plus
- Elements, B, Cr, V, Li
- Lipids, > 1,000, plus
- Nitrogen compounds, > 1,000 (proteins)
- Phenolics, > 7,000
- Probiotics, > 100
- Sulfur compounds > 10
Many other food components are reaching the large intestine, and made (metabolomics) in the large intestine.

Single Focus: Dietary Fiber
Key Topics

- Dietary Fiber
- **Essentiality**
- Intestinal development, morphology and cellular function; plus animal studies
- Microbiota and diet-DF, distribution and total
- Fermentation, SCFA and …..
- Immunity
- Additional (indirect) observations supporting DF essentiality (5 points)
- Laxation
DF is Essential

- IOM says “No” to DF essentiality because there is no “functional bowel” disorders, or a deficiency syndrome, or “disease”

- However, what is constipation, diverticular disease, colon polyps, hemorrhoids, and irritable bowel syndrome (IBS) or general functional bowel disorders, and possibly dyspepsia brought about inadequate dietary fiber intake? (not glamorous)

1The microbiota is essential too
Key Topics

- Dietary Fiber
- Essentaility
- **Intestinal development, morphology and cellular function, goblet; plus animal studies**
- Microbiota, distribution and total
- Fermentation, SCFA and ..... 
- Immunity
- Additional (indirect) observations supporting DF essentaility (4 points)
- Laxation
Within the intestine, what are the morphological, physiological, biochemical, microbiota, and metabolomic changes with increasing DF intakes?


(a) Mucus thickness
Altered mucus properties

(b) Vessel density

(c) AMP and IgA production

(b) Immature Peyer's patch

(c) Peyer's patch

(d) B. fragilis
PSA

(e) T_{reg} cell

(f) SFB

(g) T_{h17} cell
Without adequate DF, with total parenteral nutrition and in germ-free animals, have moderate to severe:

1. Near or total intestinal atrophy

2. Impaired nutrient digestion and absorption

3. Limited or no microbiota and SCFA

4. Increased intestinal permeability; “leaky gut”

5. Limited-impaired immune systems, functions
Goblet Cells and Mucin

- Stimulated by dietary fiber, more goblet cells, more mucin.
- Two layers, attached to epithelial cells, inner layer is dense, outer layer less dense and holds *Akkermansia muciniphila*, a mucin degrader.
- Much more in colon
- Mucin, but primarily dietary fiber, and sloughed epithelial cells are the primary energy sources for the microbiota
Mucus is a determinant of gut immune specification and immune tolerance

Belkaid and Grainger, Science, 342:432-433
Intestinal Development, Morphology And Cellular Function; Animal Studies

- Abrams, et.al., Influence of the normal Flora on Mucosal Morphology and Cellular Renewal in the Ileum, Lab Invest, 1963

- Fisher, et. al., Cereal dietary fiber consumption and diverticular disease: a life span study in rats, AM J Clin Nutr, 1985


- Sharma, et. Al., Rat intestinal mucosal responses to microbioal flora and differetn diets, Gut, 1994

- Frankel, et. al., Fiber; Effect on Bacterial Translocation and Intestinal Mucin content, ….. World J Surg, 1995
Key Topics

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Microbiota Impact on Host Physiology

**Metabolism**
- Energy expenditure $\downarrow$
- Nutrient accessibility $\uparrow$
- Short-chain fatty acids $\uparrow$ $\downarrow$
- Adiposity $\uparrow$

**Intestinal vessel formation**
- TF glycosylation
- Thrombin cleavage $\downarrow$
- PAR1 activation $\downarrow$
- TF phosphorylation $\downarrow$
- ANG1 expression $\downarrow$
- Vascularization $\downarrow$

**Intestinal function**
- GALT maturation $\uparrow$
- Tissue regeneration $\uparrow$
- Gut motility $\uparrow$
- Permeability $\downarrow$

**Bone homeostasis**
- $T_H$ 17 cells $\uparrow$
- TNF in colon and bone $\uparrow$
- Osteoclastogenesis $\uparrow$
- Bone mass $\downarrow$

**Behaviour**
- Synaptic connectivity $\downarrow$
- Anxiety $\uparrow$
- Pain perception $\uparrow$

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Image showing human anatomy with various organs and systems affected by microbiota impact.
Altered intestinal microbiota

Factors:
- Antibiotics
- Lifestyle
- Diet
- Hygiene

Consequences:
- Hyperimmunity (IL-6, IL-12, TNF)
- Immunodeficiency (NOD2, IL-10)
- Chronic inflammation
- Metabolic dysfunction
De Flippo, et al., Diet & Microbiota in African Children, Village of Burkina Faso (BF) and European Children (EU), PNAS, 2010

Children 1-6 yrs old
BF 10-14 g DF/day; EU 5-9 g DF/day
Microbiota and Diets

Microbiota-accessible carbohydrates (MACs)

And not enough women

Sonnenburg and Sonnenburg, Starving our Microbial Self: The Deleterious Consequences of a Diet Deficient in Microbiota-Accessible Carbohydrates, Cell Metabolism, 20:779-786, 2014

CC Kao et al, J Nutr 2016
Absence of Enteral Nutrition Decreases Microbial Diversity

Figure 2 Microbial communities in children with SBS on PN (1A, 3A, 8A, 9A, 12A), SBS children weaned from PN (2A, 4A, 11A, 13A, 16A, 18A), and siblings (2C1, 2C2, 11C1, 11C2, 12C, 13C1, 13C2). The figure is showing the relative abundance of the 19 most common taxonomic families that accounts for at least 84% of the abundance in all samples.
Shannon Diversity Index in Children with SBS still on PN or weaned from PN

H Engstrand Lilja et al, Microbiome 3:18, 2015
Diets for Multi-Generation Mouse Study

• High-MAC LabDiet 5010 Laboratory Autoclavable Rodent Diet
  – Ground corn, dehulled soybean meal, wheat middlings, fish meal, whole wheat, wheat germ, brewers yeast, ground oats, alfalfa meal, beet pulp, many other ingredients
  – 23% protein, 5% fat, 15% Neutral Detergent Fiber, 8% ash

• Lo-MAC Harlan Purified Diet TD.86489
  – 21% casein, 32% sucrose, 32% corn starch, 5% corn oil, 5% cellulose

Fecal Transplant and Hi-MAC Diet Restore Microbiota Diversity

Loss of Glycoside Hydrolase Family Members in Generation 4

Gut Microbiota Functions

Nature 2006
Energy Distribution

Why?

Energy value of resistant maltodextrin (kcal/g)

Subject  Baer, et.al., J. Nutr., 2014
A randomized, placebo-controlled, double-blind crossover study was conducted (n = 14 men) to determine the ME of RMD and its influence on fecal excretion of macronutrients and microbiota. 1

Non-Dig Oligosaccharide 1

<table>
<thead>
<tr>
<th>g/day</th>
<th>0</th>
<th>25</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total fecal Wt, g</td>
<td>118\textsuperscript{a}</td>
<td>148\textsuperscript{b}</td>
<td>161\textsuperscript{b}</td>
</tr>
<tr>
<td>Dry fecal Wt, g</td>
<td>25.5\textsuperscript{a}</td>
<td>33.0\textsuperscript{b}</td>
<td>35.8\textsuperscript{b}</td>
</tr>
</tbody>
</table>
What happens to the energy from resistant maltodextrin (RMD)?

1.95 kcal/g

RMD 3.8 kcal/g

1.85 kcal/g

Bear et. al., 2009
Excretion - Feces

Feces - Wet Weight, g

- 118.1
- 148.3
- 160.9

SEM = 7.0; p = 0.001

a < b < c

0 25 50

Feces – Dry Weight, g

- 26.5
- 32.0
- 35.8

SEM = 1.5; p < 0.0001

a < b < c

0 25 50

g RMD/day

Baer et. al., 2009

Baer et. al., 2009

g RMD/day
Excretion - Bacteria

Change in Bifidobacteria by q PCR – genomes/ng

Placebo 50 g RMD/d

Mai, et. al., 2009
Microbiota

With over 500 species in the intestine and a corresponding microbiome in the billions, this essential ecosystem of commensal, symbiotic, and pathogenic microorganisms, which appears to be unique to each of us, has profound influences on general well being of the intestitne and thus the host. Its’ existence is dependent on dietary fiber. Sweet Music!
Key Topics

• Dietary Fiber
• Essentaility
• Intestinal development, morphology and cellular function, goblet; plus animal studies
• Microbiota and diet-DF, distribution and total
• Fermentation, SCFA and ..... 
• Immunity
• Additional (indirect) observations supporting DF essentiality (4 points) 
• Laxation
SCFA in Total Parenteral Nutrition

Bartholome, et.al., J Par & Ent Nutr, 2014
Butyric Acid

Normal colon

- Promotes the integrity of the mucosal barrier
- Modulates the immune and inflammatory response
- Moderates fluid and electrolyte flux
- Regulates colonic motility
- Regulates cell growth and differentiation

Colorectal tumour

- Induces apoptosis
- Inhibits proliferation
- Induces differentiation
- Inhibits the cell cycle
- Inhibits HDAC activity
- Inhibits angiogenesis
Key Topics

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Demonstrated that SCFA bind to GRP43 (G-protein coupled receptor) in the normal resolution of certain inflammatory responses in colitis induced mice.

Without adequate DF, with total parenteral nutrition and in germ-free animals, all without adequate microbiota, fermentation and especially SCFA, the full development and adequate protection offered by the immune system is impaired to include:

1. Production of IgA and antimicrobial peptides
2. Immune cell differentiation
3. Mucus layers
4. Tight interconnected intestinal lining
5. Stimulated development of lymphoid structures
6. Peyer’s patches
Additional (indirect) Observations Supporting DF Essentiality

1. DF Hypothesis
2. Total Parenteral Nutrition; DF free diets
3. Germ Free Animals
4. Translocation, *Clostridium difficile*
1. Dietary Fiber Hypothesis

“A diet that is rich in foods which contain plant cell walls (for example, high extraction cereals, fruits, and vegetables) is protective against a range of disease, in particular those prevalent in affluent Western communities (for example, constipation, diverticular disease, large bowel cancer, coronary heart disease, diabetes, obesity, and gallstones).”

“In some instances a diet providing a low intake of plant cell walls is a causative factor in the etiology of the disease and in others it provides the conditions under which other etiological factors are more active.”

Davie Southgate, 1986 and Personal Communications
Dry Weight

- Bacteria: 20 - 25%
- Ash: 3 - 10%
- Nitrogen compounds: 20 - 30%
- Carbohydrate: 20 - 30%
- Fat: 3 - 5%

Human feces fairly consistent with 70% moisture.
2. Total Parenteral Nutrition

- Loss of systemic and particularly mucosal immune function and populations, particularly intraepithelial lymphocytes (IEL).
- Increased infectious complication, more Gram-Negative Proteobacteria
- Decreased brush boarder enzymes
- Villus atrophy
- Loss of epithelial barrier function "leaky gut"  
  Dan Teitelbaum, et al.
3. Germ Free Animal

**Reduced:**
- Mucosal cell turnover
- Digestive enzyme activity
- Local cytokine production
- Mucosal-associated lymphoid tissue
- Serum immunoglobulin level
- Lamina propria cellularity
- Vascularity
- Muscle wall thickness
- Intraepithelial lymphocytes
- Motility

**Increased:**
- Susceptibility to infection
- Enterochromaffin cell area
- Caloric intake to sustain body weight; need 20% more calories
- Accumulated colonic mucin

1. Free living
2. Fecal transplants
   - a. *Clostridium difficile*
   - b. Colitis
   - c. Constipation
   - d. Irritable bowel syndrome
3. Probiotics

**Improved intestinal structural, metabolic and physiological functions**
4. Translocation; *Clostridium difficile*¹

- Possibly the best example of a healthy and normal - what is healthy and normal - microbiota to counter the actions of a pathogen. Transforms original microbiota. Can’t be done with a single or multiple probiotics.

- A normal and healthy microbiota contains more than bacteria

Enteral Nutrition With & W/O DF

Methods: Fifteen patients [11M/4F, aged 53 (40–73)] on total EN for 43 (1–310) months for dysphagia received a fibre-free formula for 7 days, followed in a random order by either the multi-fibre-enriched formula for 14 days and then the fibre-free formula for 14 days or vice versa. Stool samples were taken at the end of each period for measurement of SCFAs levels and different groups of bacteria. Results were compared with non-parametric tests.

Fecal SCFA levels at end of 14-day period

<table>
<thead>
<tr>
<th></th>
<th>Baseline En</th>
<th>Fibre-Free En</th>
<th>Multi-Fibre En</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic</td>
<td>29</td>
<td>36</td>
<td>50*</td>
</tr>
<tr>
<td>Propionic</td>
<td>9</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Butyric</td>
<td>1</td>
<td>4</td>
<td>5**</td>
</tr>
<tr>
<td>Total SCFAs</td>
<td>37</td>
<td>50</td>
<td>67**</td>
</tr>
</tbody>
</table>

• P < 0.05 vs baseline; ** P < 0.05 baseline and fibre-free En

Schneider et al., Clin. Nutr., 2006
Key Topics

- Dietary Fiber
- Essentaility
- Intestinal development, morphology and cellular function, goblet; plus animal studies
- Microbiota and diet-DF, distribution and total
- Fermentation, SCFA and .....  
- Immunity
- Additional (indirect) observations supporting DF essentiality (4 points)
- Laxation
Laxation: Intestinal morphology and cellular function

Summary Comments

4. Laxation is more than peristalsis and decreased fecal transit times and more frequent bowel movements.

5. Laxation is the complete physiological and biochemical process of the intestine and colon functioning properly.
How Much DF is Enough?
Why Lacking in DF?

- While DF is essential and beneficial:
  - Are current intakes of DF, 18 g/day for Males and 14 g/day for Females adequate?
  - Are Adequate Intakes (AI) of 38 g/day for Males and 25 g/day for Females too high?
  - What is an approximate absolute minimum intake for DF per day? (5 to 10 g)
  - Can there be an acceptance of using/consuming added fiber to foods and beverages?
Concerns: DF vs Added Fiber

- Inadequate intake of foods traditionally considered primary sources of DF (i.e., fruits, vegetables and cereal/grains)
- That the diversity, variety, of traditional sources of DF containing food is declining.
- The previous two comments suggest the diversity of the microbiota is declining and,
- The lack of a robust microbiota leads to a less robust metabolomic ecological environment (ie., less metabolic end-products (       ) and enzyme activity (glucosidases and lyases))
Concerns: *Added Fiber*

- Only a source of nondigestible carbohydrates.
- Does not provide any “natural” compounds, a complex mixture, found in “natural”, unprocessed foods.
- Does *added fiber* have the same essential and/or beneficial biochemical and biochemical suggested for/with/in “natural”, unprocessed foods?
- Are there any possible adverse effects associated with the consumption of added fiber?
### Estimated Calorie and DF Intakes by Age, Gender and Physical Activity

<table>
<thead>
<tr>
<th>Age Ranges 19-65</th>
<th>Sedentary</th>
<th>Moderately Active</th>
<th>Active</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Males</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calories</td>
<td>2,400</td>
<td>2,600</td>
<td>3,000</td>
</tr>
<tr>
<td>Dietary Fiber, g</td>
<td>34</td>
<td>36</td>
<td>42</td>
</tr>
<tr>
<td><strong>Females</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calories</td>
<td>1,800</td>
<td>2,000</td>
<td>2,200</td>
</tr>
<tr>
<td>Dietary fiber, g</td>
<td>25</td>
<td>28</td>
<td>31</td>
</tr>
</tbody>
</table>
To Fill the Daily Fiber Gap of 15 g/day will require one of the following:

<table>
<thead>
<tr>
<th>USDA Data</th>
<th>kcal</th>
<th>g</th>
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<tbody>
<tr>
<td>Apples</td>
<td>325</td>
<td>550</td>
</tr>
<tr>
<td>Carrots, raw</td>
<td>218</td>
<td>510</td>
</tr>
<tr>
<td>Corn, sweet</td>
<td>615</td>
<td>625</td>
</tr>
<tr>
<td>Oat cereal</td>
<td>622</td>
<td>745</td>
</tr>
<tr>
<td>Wheat bread</td>
<td>522</td>
<td>224</td>
</tr>
<tr>
<td>Fibersol®-2</td>
<td>27</td>
<td>17</td>
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</table>
What is the evidence that dietary fiber from whole foods and dietary supplements is beneficial in diabetes?

Conclusion Statement. Based on the current data, diets providing 30 to 50 g fiber/day from whole food sources consistently produce lower serum glucose levels compared to a low-fiber diet. Fiber supplements providing doses of 10 to 29 g/day may have some benefit in terms of glycemic control.
AN&D Position Statement-2008

Cardiovascular Disease

• What is the evidence that dietary fiber from whole foods and dietary supplements is beneficial in cardiovascular disease?

• Conclusion Statement. Based on current data, dietary fiber intake from whole foods or supplements may lower blood pressure, improve serum lipid levels, and reduce indicators of inflammation. Benefits may occur with intakes of 12 to 33 g fiber per day from whole foods or up to 42.5 g fiber per day from supplements.
AN&D Position Statement-2008

Weight Control

• What is the evidence that dietary fiber from whole foods and dietary supplements is beneficial in obesity?

• Conclusion Statement. Based on current data, dietary fiber intake from whole foods or supplements may have some benefit in terms of weight loss and other health outcomes. Benefits may occur with intakes of 20 to 27 g/day from whole foods or up to 20 g fiber per day from supplements.
Summary

Before there are dietary fiber’s “beneficial physiological effects for human health”, there first are essential biochemical/physiological functions/benefits

Increase Intake
Thank You