Unfolding Science behind Whole Grains

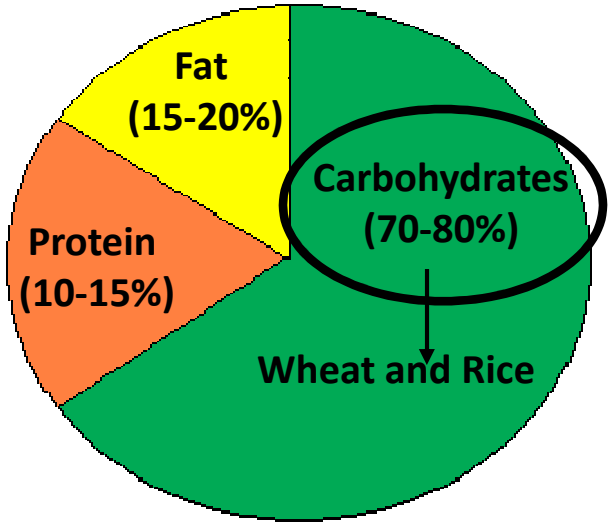
GAYATRI DAWDA

NUTRITIONIST, MARICO FOODS

Indian Diet

Indian Meal Composition

(% in total calories)



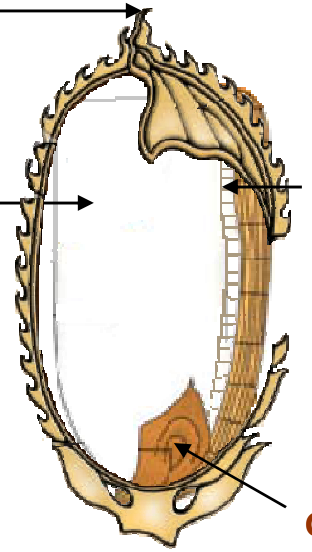
- Proportion of carbohydrates in Indian food is much higher than western world
- Carbohydrates = Cereals
- Cereals → Very Complex Carbohydrates in synergy with other nutrients

Nature has enabled each living to develop defence mechanisms

Can we use these defences (wholegrain) in our diet?

* Source: Dietary Guidelines for Indians. NIN, Hyderabad

Grain Structure



Wheat wholegrain → 10–14% bran, 2·5–3·0% germ and 80–85% endosperm

	Wheat wholegrain	(Bran + Germ) / Total
Fiber	13%	52%
Bioactive	2%	24%

- **Bioactive compounds**
  - **Synergy between compounds**
  - **Accessibility/location in food matrix**
- **Refining separates germ and bran (contains higher bioactivity)**
- **Losses in Refining → Fiber (58%), Magnesium (83%), Zinc (79%), Selenium (92%), Nicotinic acid (70%) & Folate (61%)**

Ref: Anthony Fardet. New hypotheses for the health-protective mechanisms of whole-grain cereals: what is beyond fibre? Nutrition Research Reviews (2010), 23, 65–134

Definition of Wholegrain

AACC (1999): 'Whole grains shall consist of the intact, ground, cracked or flaked caryopsis, whose principal anatomical components – the starchy endosperm, germ and bran – are present in the same relative proportions as they exist in the intact caryopsis'

Whole Grains Council (2004): '… processed (e.g. cracked, crushed, rolled, extruded, and/or cooked), the food product should deliver approximately the same rich balance of nutrients that are found in the original grain seed'

- **AACC – Minimum processed cereal, lightly pearled barley, wheat to make allowance for the small losses happen**
- **Milling → Removes germ (high content of lipid)**
- **Recombination is never 100% perfect**
- **"as they exist in the intact caryopsis to the extent feasible by best modern milling technology"**

Protective Physiological Mechanisms

- Mechanical (Insoluble Fiber)
- Hormonal (Zinc, Selenium and Nicotinic Acid)
- Antioxidative and Anti –inflammatory (All micronutrients)
- Cell signaling (Polyphenols and redox status)
- Energy metabolism (B - complex vitamins)

Still Consumption is Low

– Unlike fruits and vegetables → Benefits not known

– Wholegrain not very tasty

– Wholegrain cereal products are less common

– Time and money as obstacles to eating more nutritionally

Health Benefits : Current Hypotheses

- Rich source of Dietary Fiber – “second meal effect”
- Anti - carcinogens
- Antioxidants
- Rich source of Magnesium
- Action of anti-nutrients
- Food structure (Intact structure is more important than processed)

New Proposed Hypothesis

- Antioxidants – Polyphenols/flavonoids in cell signalling
  - Regulation of redox status of cells through NF kB and AP-1
  - Increase synthesis of GSH (endogenous antioxidant)
- Source of sulphur compounds
  - Methionine and cystine – precursors of GSH
  - Rye – 0.6% free methionine had higher hepatic GSH
- Uric acid
  - Powerful antioxidant (40- 50% of plasma antioxidant capacity)
- Role of lipotropes and methyl donors
  - Betaines, choline, folates, methionine and myoinositol
- Role of lignins
- Combined role of B-complex vitamins

Wholegrain Nutrients

Cereal Grains → good source of protein, dietary fiber, unsaturated fatty acids, vitamins, minerals and specific bioactives.

Specific Bioactives

Oats

Avenanthra-mides, β-glucan

Barley

Lunasin, β-glucan

Buckwheat

Contains Rutin

Rye

Contains Alkylresorcinols

Amaranth

High level of very complete protein; contains lysine

Wheat

Ferulic acid, Phytic acid, and Insoluble Fiber

OATS - Avena sativa

- Feasible, economical, nutritious, convenient
- High Benefit to Cost ratio
- Parts of grain remain intact even on processing
- Varied Meal occasions – Breakfast, Snacks, Main meals
- 80% to 107% lower fat intake with RTC oats as compared with RTC soups/Noodles

Nutritional Components of Oats

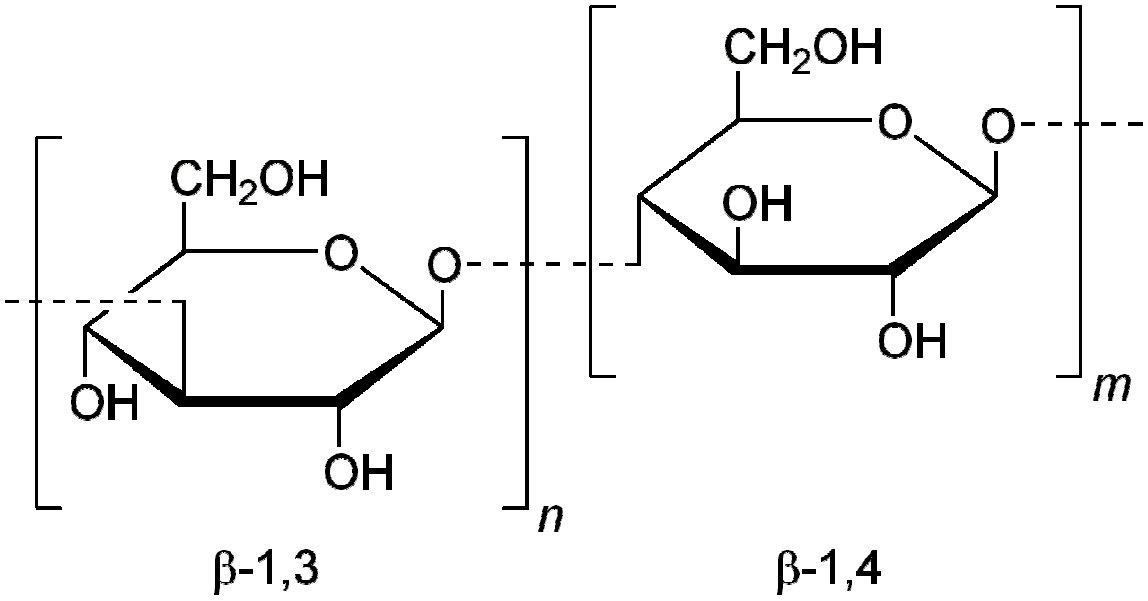
Component of oat	Availability in oat (%)
Starch	60 %
Protein	Total: 11–15 %
	Globulins: 80 % of total protein
	Prolamins: 15 % of total protein
	Glutelin: 5–66%of total protein
	Albumin: 1–12 % of total protein
Lipid	5–9 %
Dietary fibres	*β*-glucan: 2.3–8.5 %

Trace Minerals	Calcium : 0.54 %
	Iron : 0.047 %
Vitamins	Thiamine : 0.002 %
	Riboflavin : 0.001 %
	Niacin : 0.032 %

Phytochemicals	α-Tocotrienols and α-tocopherols:
	86–91 % of total tocols
	Phenolic compounds: 5.7 %
	Protocatechuic
	p-hydroxy benzoic acid
	Vanillic
	Syringic
	Ferulic
	Caffeic
	p-coumaric
	Sinapic
	Flavonoids (trace amounts) :
	Apigenin
	Glycosylvitexin
	Isovitexin
	Tricin
	Vitexin
	Avenanthramides:
	AVA1: 2.1–4.3 %
	AVA3: 2.8–6.2 %
	AVA4: 2.5–4.7 %

Source : Rasane etal. Nutritional advantages of oats and opportunities for its processing as value added foods - a review. J Food Sci Technol. 2015 Feb; 52(2): 662–675.

B-Glucan



- Oat β-glucan (OβG) consists mainly of the linear polysaccharide (1→3), (1→4)-β-D-glucan and is often called β-glucan.
- It is a nondigestible polysaccharide (a chain of glucose molecules that is found in foods such as oats, barley, mushrooms, and yeasts
- Majorly found in the Endosperm
- Property to form Viscous solution, which depends on the Mol. Weight of B-Glucan present

Source : Daou C. etal. Oat Beta-Glucan: Its Role in Health Promotion and Prevention of Diseases. Food Science & Food Safety. 2012. Volume11, Issue4. Pages 355-365

Avenanthramides

Avenantramides are group of 20 soluble alkaloids that are conjugated to anthranilic acid.

Anti-oxidant property

74 to 142 mg/ kg oat flour (depending on type of cultivator & processing)

Clinically researched benefits :

1. **Anti-oxidant benefit (SOD & Glutathione, Reduced lipid peroxidation, blood cholesterol)**
2. **Anti-inflammatory benefit (CRP, Il-1B, NFkB & pro-inflammatory cytokines)**
3. **Reduces FBS induced vascular cell proliferation**
4. **Increases NO**

Source : J.B.Blumberg, AACC & Lin Nie, Mitchell L. Wise, David M. Peterson, Mohsen Meydani. Avenanthramides, a polyphenol from oats, inhibits vascular smooth muscle cell proliferation and enhances nitric oxide production. Atherosclerosis 186 (2006) 260–266.

Mechanism of Oats Efficacy

Beta – glucan/ Avenanthramides:

1. Increase viscosity of food liquor:

- Reduced mucosal diffusion
- Reduced mobility of fluid layers
- Lengthening of carbohydrate digestion

2. High bulking

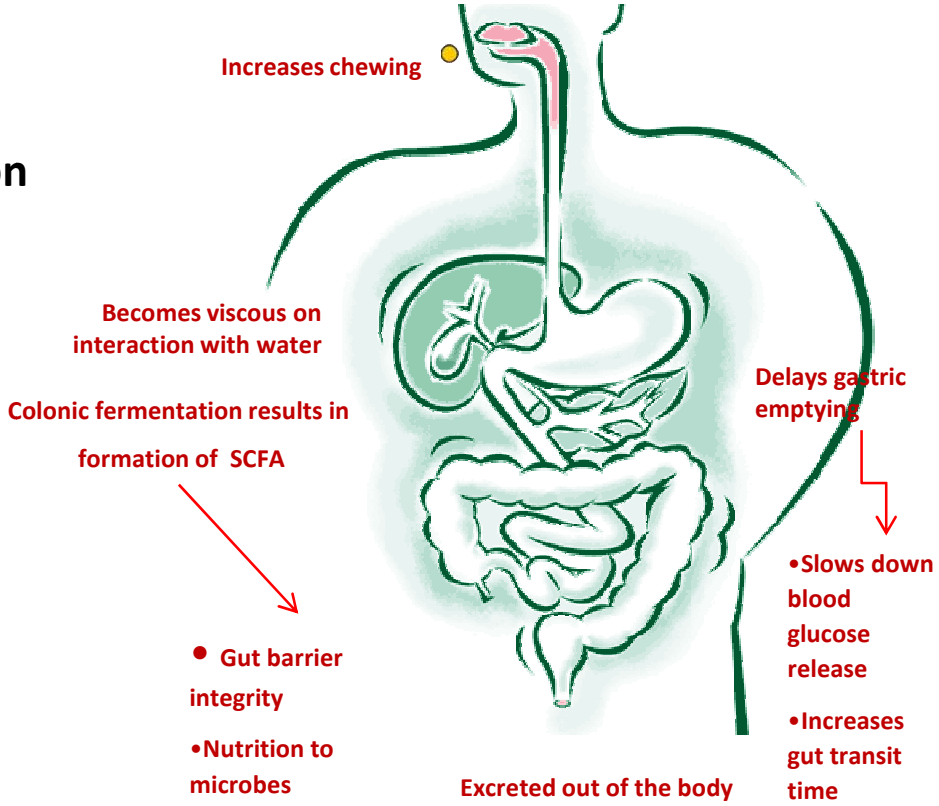
- Distention

3.Solubilisation of bile salts

- Reduction of LDL

4. Creating small chain fatty acids

- Reduction of LDL
- Gut Health

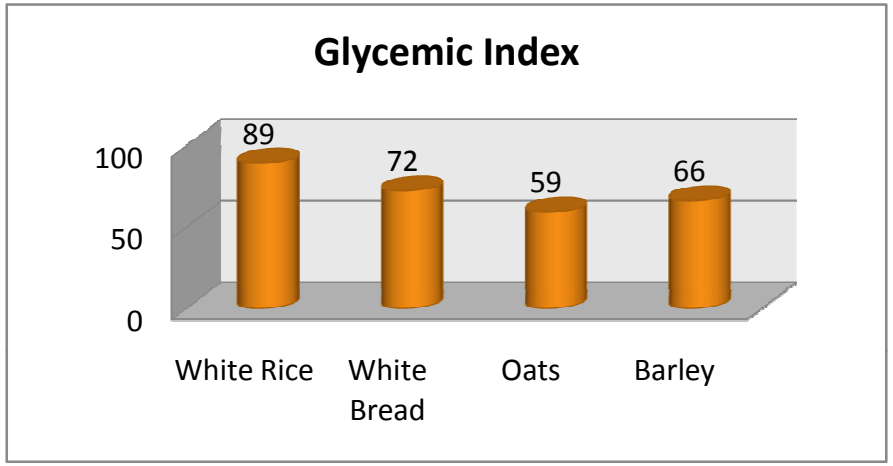


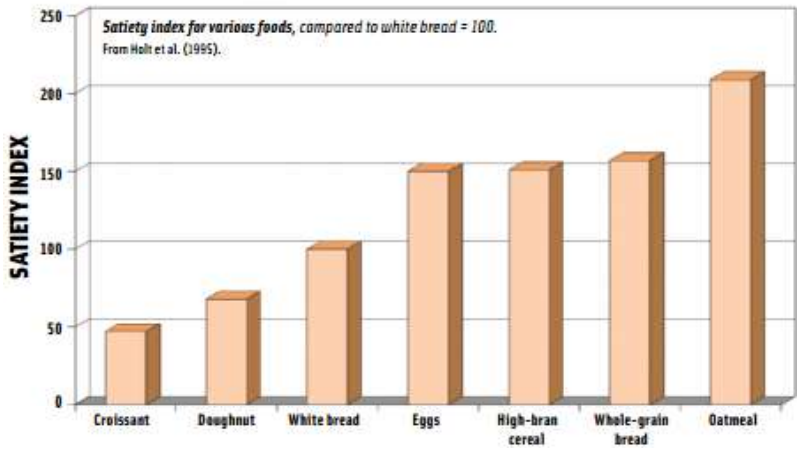
Cheickna Daou and Hui Zhang. Oat Beta-Glucan: Its Role in Health Promotion and Prevention of Diseases. Comprehensive Reviews in Food Science and Food Safety Vol. 11, 2012.pg.-355-365.

Efficacy of Oats – Clinical

Glycemic Index (GI):

- GI - Effect of a carbohydrate- containing food on blood glucose level



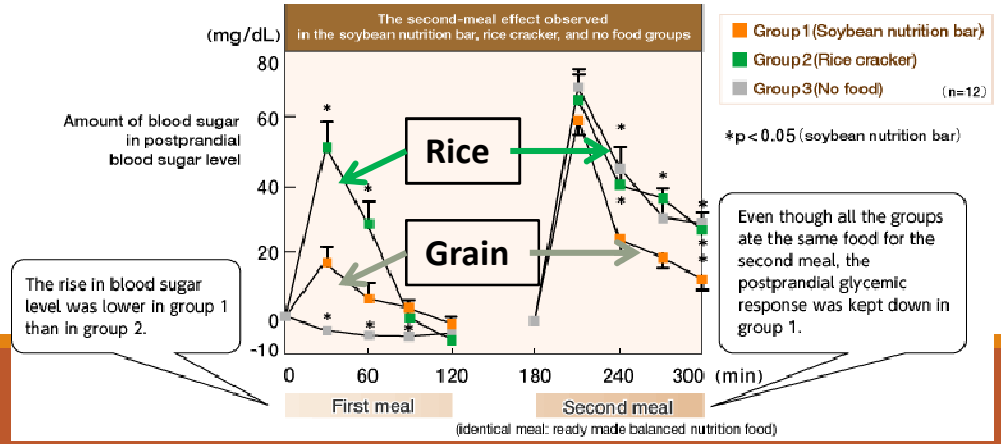


Appetite Control/ Satiety:

- Increased viscosity prolong transit time and the absorption rate of nutrients
- Enhanced interaction of nutrients with intestinal mucosa – release of appetite regulating peptides

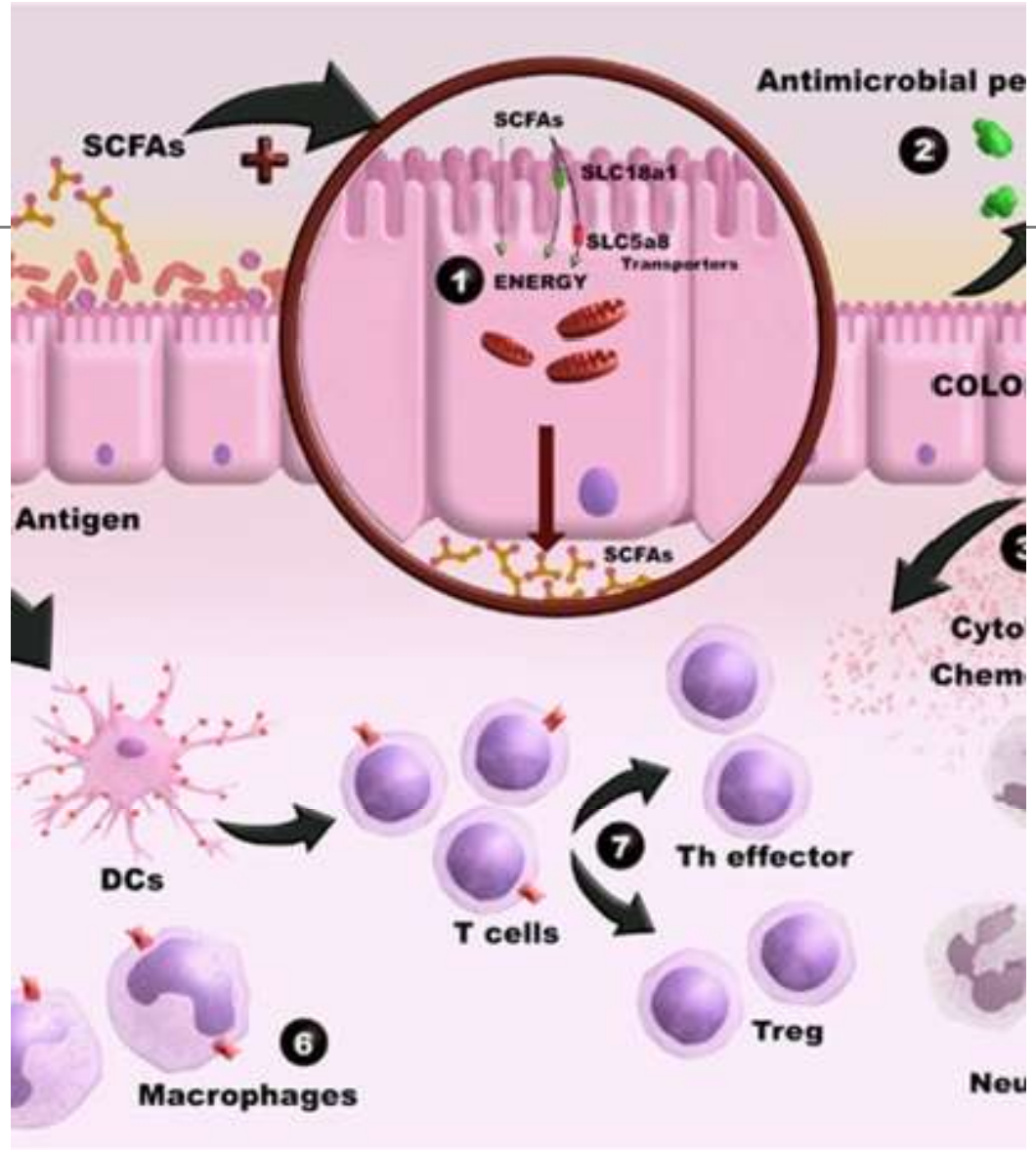
Second Meal Effect:

- Improved carbohydrates tolerance at a meal about 4 - 5 or 10 - 12 hours after low GI meal.



Source: http://www.glycemicindex.com/index.php

Immunity linked to Microbiota



SCFAs are an important link between microbiota and immune system.

SCFA – involved in Activation of macrophages & Tcells

SCFA - reduction of some pro-inflammatory cytokines such as TNF-α and IL-12

Promote differentiation of T lymphocytes

Source : Correa etal. Regulation of immune cell function by short-chain fatty acids. Clinical & translational Immunity. (2016) 5, e73; doi:10.1038/cti.2016.17

Conclusion:

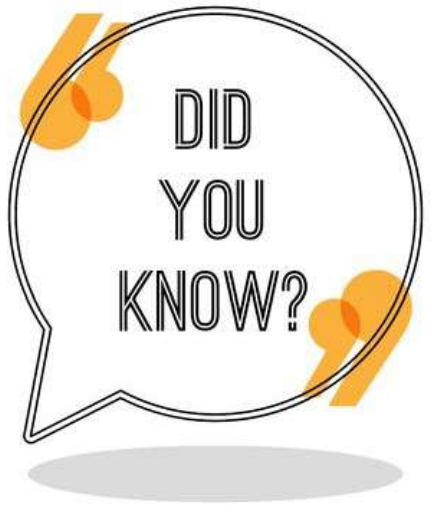
Nutritional Superiority of WHOLE GRAINS over Refined ones w.r.t

A. Dietary fibre

B. Micronutrients (Magnesium, Selenium , B- complex, Zinc)

C. Bio-actives in whole grains

Substituting even 50% of refined grains to Whole grains (Oats, Amaranth, Barley, Sorghum, Buckwheat) can boost 3 times dietary fibre intake. Easily meet Fiber recommendations



Accommodating grains like OATS, SORGHUM, AMARANTH in different meals of the day can help improve :

a. Glycemic Control
b. Blood Lipids
c. Gut Health
d. Weight Management

Possible Wise Grain Swaps

Breakfast : Poha to Oats poha

Lunch : Rice to Red Rice

Snack : Maida Bread to Multigrain bread or Quinoa Upma

Dinner : Rice khichadi to Barley Khichadi


Thank You