Accuracy of Whole Grain Composition Estimates Derived from Formulations Created for a Sample of Commercial Food Products

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At least ½ of all the grains eaten should be whole grains.

Source: http://www.mypyramid.gov/pyramid/grains_amount.aspx
Studying association of whole grains with health outcomes

Whole Grains

- CVD
- Type II Diabetes
- Obesity
- Cancer
How to quantify whole grain intake?
Current Approach: Calculate *servings of whole grains* consumed
Definition of whole grains:

Whole grains are grains that contain the **entire** grain kernel the bran, germ, and endosperm.

Examples:
- whole-wheat flour
- bulgur (cracked wheat)
- oatmeal
- whole cornmeal
- brown rice

Source: http://www.mypyramid.gov/pyramid/grains.html
What’s a serving size:

- 1 ounce bread equivalent
  - ½ cup cooked brown rice
  - ½ cup cooked oatmeal
  - 3 cups popped popcorn
  - 1 cup whole wheat cereal flakes
  - 1 slice whole wheat bread
  - 5 whole wheat crackers
  - etc.

Source:  http://www.mypyramid.gov/pyramid/grains_counts.html
Easy as pie??
It would be if foods fit neatly into one of two pots-whole grain *or* not whole grain
Nabisco Grahams

**Ingredients:** Enriched Flour (Wheat Flour, Niacin, Reduced Iron, Thiamine Mononitrate [Vitamin B1], Riboflavin [Vitamin B2], Folic Acid), **Graham Flour**, Sugar, Partially Hydrogenated Soybean Oil, Molasses Preserved With Sulfur Dioxide, High Fructose Corn Syrup, Leavening (Baking Soda, Calcium Phosphate), Salt, Malted Barley Flour.

Source: Walmart.com accessed 3/15/10
Brownberry Country Wheat Bread

Ingredients: *Whole Wheat Flour*, Unbleached Enriched Wheat Flour [Flour, Malted Barley Flour, Reduced Iron, Niacin, Thiamin Mononitrate (Vitamin B1), Riboflavin (Vitamin B2), Folic Acid], Water, Sugar, Wheat Gluten, Yeast, Soybean Oil, Molasses, Salt, Monoglycerides

Source: LundsandByerlys.com accessed 3/15/10
Goldfish Crackers with Whole Grain

**Ingredients:** *Whole Grain Wheat Flour*, Unbleached Enriched Wheat Flour [Flour, Niacin, Reduced Iron, Thiamin Mononitrate (Vitamin B1), Riboflavin (Vitamin B2), Folic Acid], Cheddar Cheese [(Pasteurized Cultured Milk, Salt, Enzymes), Annatto], Vegetable Oils (Canola, Sunflower &/Or Soybean), Contains 2% Or Less: Salt, Yeast, Autolyzed Yeast, Spices, Leavening (Baking Soda, Monocalcium Phosphate, Ammonium Bicarbonate) & Onion Powder.

Source: Walmart.com accessed 3/15/10
Rice Chex Cereal

**Ingredients:** Rice, *Whole Grain Rice*, Sugar, Salt, Molasses, Vitamin E (Mixed Tocopherols) & Bht Added to Preserve Freshness. Vitamins & Minerals: Calcium Carbonate, Iron & Zinc (Mineral Nutrients), Vitamin C (Sodium Ascorbate), A B Vitamin (Niacinamide), Vitamin B6 (Pyridoxine Hydrochloride), Vitamin B2 (Riboflavin), Vitamin B1 (Thiamin Mononitrate), Vitamin A (Palmitate), A B Vitamin (Folic Acid), Vitamin B12, Vitamin D.

*Source: Walmart.com accessed 3/15/10*
Why the proliferation of products with combo of whole and refined grains?
Mean % Partial Whole Grain and 100% Whole Grain Graham Crackers Consumed at After-School Snack Program at 4 Elementary Schools

Source: Sadeghi and Marquart, J Foodservice, 2009
How to deal with partial whole grain products in tabulating whole grain intake?

Simple

Complex
Most Simple

All grain ingredients whole grain?

Yes- Count as whole grain

No- Don’t count as whole grain
Most Simple

All grain ingredients whole grain?

Yes- Count as whole grain
No- Don’t count as whole grain

PROS AND CONS
+ Very simple
- Underestimate whole grain intake
Somewhat more complex

Consider whole grain ingredients

If first ingredient whole grain count as whole grain
If whole grain ingredient not first ingredient count as partial whole grain

If no whole grain ingredient - not a whole grain
Somewhat more complex

Consider whole grain ingredients

If first ingredient whole grain count as *whole grain*

If whole grain ingredient not first count as *partial whole grain*

If no whole grain ingredient- *not a whole grain*

**PROS AND CONS**

+ Tries to account for varying levels of whole grain composition
- Hard to interpret and use ‘partial WG’ classification
More Complex: Determine proportion of whole grain and non-whole grain components
Cracked Wheat Bread, 1 slice = 0.58 servings of whole grains

Recipe
1 1/2 c. boiling water
3/4 c. cracked wheat (bulgar)
2 pkg. yeast
1/4 c. very warm water
1/2 tsp. sugar or honey
1/4 tsp. ginger
1/4 c. unsulphured molasses
2 tbsp. honey
1/4 c. butter
1 tsp. salt
1 c. buttermilk
2 c. white flour
1 c. whole wheat
1 c. cracked wheat

Total grains:
3/4 c + 2 c + 1 c + 1 c = 4.75 cups total
Whole grains:
3/4 c + 1 c + 1 c = 2.75 cups
Proportion Whole:
(2.75 c / 4.75 c) x 100 = 58%

1 slice = 0.58 servings of whole grains
Pros and Cons of Proportions Approach

Pros

+ More precise estimates of whole grains consumed
Pros and Cons of Proportions Approach

Pros
+ More precise estimates of whole grains consumed

Cons
+ Complicated to implement
+ Assumptions must be made for commercial food products, which threatens validity
Ritz Whole Wheat Crackers

**INGREDIENTS:** ENRICHED FLOUR (WHEAT FLOUR, NIACIN, REDUCED IRON, THIAMINE MONONITRATE {VITAMIN B1}, RIBOFLAVIN {VITAMIN B2}, FOLIC ACID), WHOLE GRAIN WHEAT FLOUR, SOYBEAN OIL, SUGAR, PARTIALLY HYDROGENATED COTTONSEED OIL, LEAVENING (CALCIUM PHOSPHATE AND/OR BAKING SODA), SALT, HIGH FRUCTOSE CORN SYRUP, SOY LECITHIN (EMULSIFIER), CORNSTARCH. CONTAINS: WHEAT, SOY.

Source: Walmart.com accessed 3/15/10
Database nutritionists create recipes/formulations using software that...

Estimates ingredient amounts that
- Follow ingredient statement convention

AND
- Produce a recipe with a nutrient composition profile that closely matches nutrition facts panel information
Good Enough for Whole Grains??
Nabisco Wheat Thins Product Line

11 grams whole grains per serving

16 grams whole grains per serving

22 grams whole grains per serving

Source: Nabiscoworld.com accessed 3/15/10
Methodology

- Identified products in bread, cracker, ready-to-eat cereal and snack chip aisles of chain supermarket that had grams of whole grain per serving specified on product packaging
- Collected ingredient statement & nutrition facts panel information for these products and created formulations using food calculation software
- Whole grain estimates on product packaging were compared with estimate from ingredient amounts determined using the software
Mean labeled and calculated whole grain content, 
n=52 products

Labeled: 15 grams
Calculated: 14.1 grams

r = 0.95
Difference between the labeled and calculated whole grain values, n=52 products
Difference between the labeled and calculated whole grain values, n=52 products
Discussion

- Results suggest that it may be possible to estimate the whole grain content of commercial food products with reasonable accuracy for most products.

- More complicated foods need to be examined.
Kashi®
Pocket Bread
Chicken Rustico

Nutrition Facts
Serving Size 1 Piece (156g)
Servings Per Container 1

Amount Per Serving
Calories 300  Calories from Fat 70
% Daily Value
Total Fat 8g 12%
  Saturated Fat 2g 10%
  Trans Fat 0g
Cholesterol 20mg 7%
Sodium 670mg 28%
Potassium 420mg 12%
Total Carbohydrate 41g 14%
  Dietary Fiber 4g 17%
  Sugars 4g
Protein 16g 30%

Vitamin A 3%  Vitamin C 8%
Calcium 10%  Iron 10%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Calories 2,000  2,500
Total Fat Less than 65g  48g
  Saturated Fat Less than 20g  25g
  Trans Fat 2g  2g
Cholesterol Less than 300mg  200mg
Sodium Less than 2,400mg  2,400mg
Potassium 3,500mg  3,500mg
Total Carbohydrate 300g  36g
  Dietary Fiber 25g  30g
  Sugars 30g  50g
Protein 56g  66g

Ingredients: Bread [KASHI SEVEN WHOLE GRAINS & SESAME® FLOUR, INCLUDING OATS, LONG GRAIN BROWN RICE, RYE, HARD RED WHEAT, TRITICALE, DERHULLED BARLEY, BUCKWHEAT, SESAME SEEDS], WATER, WHEAT FLOUR, BROWN RICE SYRUP, EXPELLER PRESSURED CANOLA OIL, WHEAT GLUTEN, DRIED YEAST, SALT, BAKING SODA, CITRIC ACID, COOKED CHICKEN (CHICKEN BREAST WITH BIB MEAT), WATER, RICE STARCH, SEA SALT, GARLIC, ONION, BLACK PEPPER, WHITE PEPPER, DILL, CRIMINI MUSHROOMS, ROASTED RED SWEET PEPPERS, PARMESAN CHEESE (PASTEURIZED PART-Skim MILK, CHEESE CULTURE, SALT, ENZYMES), DICED TOMATOES (DICED TOMATOES, TOMATO JUICE, CITRIC ACID, SALT, SODIUM HYLORIDE, CHLORIC HYDROGEN WATER), WATER, TOMATO PASTE (TOMATOES), ROASTED GARLIC, TOMATOES, EXTRA VIRGIN OLIVE OIL, ONIONS, CORNSTARCH, SALT, SPICE, GARLIC (GARLIC, WATER), RICE STARCH, GROUND FLAX SEEDS, EVAPORATED CANE JUICE CRYSTALS, GUAR GUM, XANTHAN GUM.

CONTAINS WHEAT, MILK AND EGG.

INGREDIENTS.
Conclusion

- Use of more sophisticated approaches to estimating whole grain content of foods warranted given nature of the food marketplace.