Micronutrient enrichment & fortification make a difference in US diets

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Agenda

• Do enrichment and fortification make a meaningful difference in US micronutrient intakes?

• What challenges remain?
Strategies for Increasing Nutrients

• Choose vehicle
  – Foods
    • with naturally occurring nutrients
    • added nutrients (fortification, enrichment)
  – Dietary supplements

• Get target group to eat/use enough to deliver the desired amount
Fortification Criteria

- Safe
- Effective
- Benefits nutritional status of population
- Not excessive or harmful (especially if many foods fortified with same nutrients and supplements used)
- Label
To increase micronutrient intakes foods must also be

• Satisfying
• Available
• Convenient
• Economical
Problems

• Fortification impact varies by age, sex, physiological group
  – Not everyone eats fortified food if only one is fortified
  – People with worst diets often don’t eat fortified foods

• Fortifying several foods may hit more people
  – but more difficult to assess impact and avoid excess

• Supplements complicate further
Problems

- Excess
- Technical difficulties
What is the evidence micronutrient fortification/enrichment make a difference in US diets?
Data Development

• ILSI North America’s Fortification Committee initiated and funded the development of data
• Data development and analysis conducted by Nutrition Impact, LLC by D. Keast, V. Fulgoni
• ILSI NA Science Advisor- Johanna Dwyer, DSC, RD, Gov’t Liaison- Regan Bailey, Ph.D, RD
Methodology

- NHANES 03-04 and 05-06 dietary intake data
- NCI method to estimate usual intakes
- USDA FNDDS 2.0 and 3.0 and standard release 18 and 20 used for 03-04 and 05-06 food composition data, respectively*
- Database created to separate the amount of intrinsic and added nutrients found in each food (included voluntary according to FDA standards for added B 1, B2 niacin, iron, A, folic D and discretionary (nutrient additions other than those defined by FDA for enriched/fortified foods)
< EAR

• The lower the % of people under the Estimated Average Requirement (EAR), the greater the chances they are meeting their nutrient needs

(lower % is **better** dietary status)
Prevalence (%) of Intakes < EAR by source in Americans, ages 2+y

- Vitamin A: Naturally occurring 74%, Enriched/Fortified 45%, Total (Foods + Supplements) 34%
- Vitamin D: Naturally occurring 100%, Enriched/Fortified 93%, Total (Foods + Supplements) 70%
- Vitamin E: Naturally occurring 93%, Enriched/Fortified 91%, Total (Foods + Supplements) 60%
- Folate: Naturally occurring 88%, Enriched/Fortified 11%, Total (Foods + Supplements) 8%
- Vitamin C: Naturally occurring 46%, Enriched/Fortified 37%, Total (Foods + Supplements) 25%

Fulgoni VL, Keast DR, Bailey RL, Dwyer J. Journal of Nutrition, 2011;141(10)L1805-12
Prevalence (%) of Intakes < EAR by source in Americans, ages 2+y

- Thiamin: Naturally occurring 51%, Enriched/Fortified 6%, Total (Foods + Supplements) 4%
- Riboflavin: Naturally occurring 9%, Enriched/Fortified 2%, Total (Foods + Supplements) 1.6%
- Niacin: Naturally occurring 11%, Enriched/Fortified 1.7%, Total (Foods + Supplements) 1.2%
- Vitamin B-6: Naturally occurring 22%, Enriched/Fortified 12%, Total (Foods + Supplements) 8%
- Vitamin B-12: Naturally occurring 6%, Enriched/Fortified 3%, Total (Foods + Supplements) 2%

Fulgoni VL, Keast DR, Bailey RL, Dwyer J. Journal of Nutrition, 2011;141(10)L1805-12
Summary

• Major sources of most water soluble vitamins were enriched/fortified foods and/or supplements
Prevalence (%) of Intakes < EAR by source in Americans, ages 2+y

- Magnesium:
  - Naturally occurring: 59%
  - Enriched/Fortified: 55%
  - Total (Foods + Supplements): 45%

- Iron:
  - Naturally occurring: 22%
  - Enriched/Fortified: 7%
  - Total (Foods + Supplements): 5%

- Zinc:
  - Naturally occurring: 15%
  - Enriched/Fortified: 11%
  - Total (Foods + Supplements): 8%

Fulgoni VL, Keast DR, Bailey RL, Dwyer J. Journal of Nutrition, 2011;141(10)L1805-12
Summary

• Major sources of most minerals (except for iron) were naturally occurring, intrinsic to foods
Summary
Fortification/Enrichment

- Fortification/enrichment important in increasing the % of population > EAR for:
  - vitamins A (from 74 to 45% < EAR)
  - thiamin (from 51 to 6% < EAR)
  - folate (from 88 to 11% < EAR)
  - iron (from 22 to 7% < EAR)

- They also helped to increase nutrient adequacy for B-2, B-6, niacin, B-12, C, D
Summary

• Few exceeded the UL

• But these measures didn’t eliminate need to increase intakes of 2010 *nutrients of concern*:  
  • D 93% still < EAR with added nutrients, 70% with supplements  
  • Calcium  
  • Potassium  
  • Fiber (analyses coming via Dr. D. Gee (ODS/NIH)
Caution

• With enrichment/fortification, increases may be greater for some age/sex groups than others, depending on foods consumed by each age/sex group
  • *Dr. Louise Berner is completing this analysis now on children*

• Analysis did not separate out different types of voluntary fortification

• Dietary inadequacy/excess is not same as nutritional status
What about supplements?

• Supplements increased the % of the population meeting the EAR
  – especially for nutrients that are not prevalent in foods (vitamins D and E)

• Supplements also increased the % > UL
Summary

- Gains in preventing dietary inadequacy were less with supplements (on a total population basis)

- Separate analyses of supplement users and nonusers told a different story (Bailey et al)
  - many did not take micronutrient-containing supplements
  - those who did take supplements weren’t always those who needed nutrients in question
Bottom Line

• With all sources of micronutrients included, most Americans met recommended nutrient targets for the majority (but not all) of vitamins and minerals evaluated.

• However.....
  – far fewer individuals would have done so without intakes of enriched and fortified foods
  – and even fewer if dietary supplements were excluded
Micronutrients of Concern

• What did fortification and enrichment contribute to US intakes today to increasing intakes of “nutrients of concern” as identified by the Dietary Guidelines 2010?
What is a micronutrient of concern??

“One falling short of recommended intake levels for substantial percentage of US citizens”

Clear public health need for more of these micronutrients by many Americans

-For others already plentiful in diets, public health rationale not so strong
Nutrients of Concern for Americans to Increase

Dietary Guidelines for Americans 2010

- Vitamin D
- Calcium
- Potassium
- Fiber
Nutrients of concern 2010

- Vitamin D
- FIBER
- CALCIUM
- POTASSIUM
Vitamin D: Some intrinsic in food, not a lot
Vitamin D: Cod and Menhaden liver oil
Vitamin D:
these fortified foods served us well in the past
Vitamin D: other fortified foods didn’t
Prevalence (%) of Intakes < EAR by source in Americans, ages 2+y

Fulgoni VL, Keast DR, Bailey RL, Dwyer J. Journal of Nutrition, 2011;141(10)L1805-12

(% getting too little)
Even with fortification, 70% still below EAR for D
Prevalence (%) of Intakes < EAR by source in Americans, ages 2+y

Calcium

<table>
<thead>
<tr>
<th>Naturally occurring</th>
<th>Enriched/Fortified</th>
<th>Total (Foods + Supplements)</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>49</td>
<td>38</td>
</tr>
</tbody>
</table>

% getting too little

Fulgoni VL, Keast DR, Bailey RL, Dwyer J. *Journal of Nutrition*, 2011;141(10)L1805-12
Foods for increasing micronutrient intakes must reach high risk target groups

Old strategies focused on dairy don’t reach some target groups (teen girls, older women) in some countries (Finland, Jordan, India, US)
D is Ireland’s “other” problem

• D Fortification sporadic
  – Mandatory D in fat spreads and cooking oils
  – Voluntary in all others but not widespread or at uniform levels

• Problem
  – D deficiency common
  – Main dietary sources of D are fish, dairy, egg yolk, mushroom, meat and fish
Micronutrient rich foods must reach high risk target groups

- Encourage naturally high calcium foods?
- New strategies needed?
  - More/higher voluntary fortification of dairy?
  - Fortified RTE and hot cereals
  - Calcium fortified orange juice
  - Bread fortified with Calcium
  - Fortified soymilk & meal replacements
  - Mushrooms irradiated to produce D?
Don’t overdo it!
D and Post WW II UK

• Margarine D fortified & many gave cod liver oil to infants and children
  – Overfortified baby milk products with D, with other sources of D caused D intoxication in infants, metastatic calcification soft tissues, etc

• **Result:** ban on fortified milk products in many European countries
  - continued skittishness on D fortification
Potassium Problem

- Increase intake of foods rich in it
- Fortify?? (not easy)
- Make new foods high in potassium (not easy)
- Supplements? (horse sized pills)
• The greater the % of population over the Adequate Intake (AI), the more likely chances are their dietary status is good
Prevalence (%) of Intakes OVER >AI by source in Americans, ages 2+y POTASSIUM

- Naturally occurring
- Enriched/Fortified
- Total (Foods + Supplements)


(%%getting enough)
Fiber not considered today

• Fiber- analysis in progress Dr. David Gee

• Major problem in US diets
Nutrients of Concern in Dietary Guidelines for Americans 2005

• Adults:
  – Vitamin A (as carotenoids)
  – Vitamin C
  – Magnesium
  – Calcium
  – Vitamin E
  – Fiber
  – Potassium

• Children
  – Calcium
  – Magnesium
  – Vitamin E
  – Potassium
Prevalence (%) of Intakes < EAR by source in Americans, ages 2+y

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Prevalence (%) of Intakes < EAR by source in Americans, ages 2+y

Fulgoni VL, Keast DR, Bailey RL, Dwyer J. Journal of Nutrition, 2011;141(10)L1805-12
Not considered today-

• Vitamin C (possible subgroup inadequacy?)

• Iron (problematic: toxicity & deficiency)
Prevalence (%) of Intakes < EAR by source in Americans, ages 2+y

- Magnesium: Naturally occurring 59%, Enriched/Fortified 55%, Total 45%
- Iron: Naturally occurring 22%, Enriched/Fortified 7%, Total 5%
- Zinc: Naturally occurring 15%, Enriched/Fortified 11%, Total 8%
- Calcium: Naturally occurring 54%, Enriched/Fortified 49%, Total 38%

(% not getting enough)

Fulgoni VL, Keast DR, Bailey RL, Dwyer J. Journal of Nutrition, 2011;141(10)L1805-12
Other Nutrients of Interest

Folic Acid
Folate: Naturally occurring food sources
Folate: fortified food sources

Whole Grains & Masa flour soon?
Prevalence (%) of Intakes < EAR by source in Americans, ages 2+y

Folate

- Naturally occurring: 88%
- Enriched/Fortified: 11%
- Total (Foods + Supplements): 8%

(got too little, now get enough, but what about too much??)

Fulgoni VL, Keast DR, Bailey RL, Dwyer J. Journal of Nutrition, 2011;141(10)L1805-12
Trends in serum folate before and after folic acid fortification, USA
Colon cancer pre and post-folic acid fortification: Age-adjusted incidence - United States & Canada
Risk-Risk

400 - 800 mcg???

1000 - ????? mcg???

deficiency excess

Marginal

Optimal

Marginal

Deficiency

Toxicity

Death

Death

Concentration or intake of nutrient

Function

100%
Other Nutrients of Interest

Vitamin K
(problematic since an anticoagulant)
Prevalence (%) of Intakes OVER > AI by source in Americans, ages 2+y: Vitamin K

Fulgoni VL, Keast DR, Bailey RL, Dwyer J. Journal of Nutrition, 2011;141(10) L1805-12
Not considered today - public health problems unlikely

- B vitamins (little evidence inadequacy)
- Zinc (no biomarker)
Prevalence (%) of Intakes < EAR by source in Americans, ages 2+y

(few getting too little)

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Summary

• Fortification and enrichment don’t solve all micronutrient adequacy problems

• Monitoring needed to identify and guard against excess of some micronutrients
Next Steps for Nutrition Science

• Importance of NHANES and other population based surveys for monitoring, surveillance, modeling
  – What do you do without such a survey?

• Who is getting too much, too little?
  – Biomarkers of intake, excess
Next Steps for Nutrition Science

- Best models for UL

- Guidelines for fortification:
  - USA, Canada, Denmark, AFSSA, EFSA?

- Best ways to label

- Best links to health claims
Next Steps for Food Science
Target those “nutrients of concern” with new efforts
Next Steps for Food Technology

• Technologies for increasing potassium in the diet without spoiling taste

• Find strategies for increasing adequacy of diets in vitamin D without exceeding upper safe levels
Next Steps for Food Technology

• More bioavailable forms of minerals Americans fall short in? (Calcium, potassium, possibly Mg)?

• Palatable sources of dietary fiber?

• Technical problems: matrices, etc.
Next Steps for Food Technology

• Are fortified foods less” healthy” than non-fortified foods (because of more calories, sugar, fat, or salt in them?)

• What should ground rules be for adding non-nutrient bioactives?
Fortification Futures?

• Iodine
  – Processed foods?
  – Supplements (prenatal)?
  – Today adventitious I in milk major source

• Folate in masa flour?

• Other strategies?
Strategies for remaining problem micronutrients

• Food based Dietary Guidelines?

• Fortify?
  – Few foods at higher levels?
    • But risk of overdose higher
    • Usual US strategy
  – Many foods at lower levels
    • Hits non-consumers of some foods
    • More difficult to monitor

• Supplement?
Fortification Future

- Rifles, not shotguns needed

- “Pixie dust” marketing (fortification of small amounts of nutrients already plentiful in diets)
  - not a public health measure
Keep amounts reasonable

• Consider *total* micronutrient intake, from all foods, not just a single product
  – Consider standardizing within product categories for voluntary efforts

• More is not always better
  – Supplement users may get too much
Consumer perception and professional backlash likely with fortification of foods high in fat, sugar, or salt

- Remember SmartChoice!
Stay tuned on labeling

Reconsider formulations when and if Nutrient Facts & Supplement Facts panels updated (EAR, RDA disputes)

Child dietary supplement formulations?
Take home

• Fortification and enrichment help Americans meet recommended nutrient targets for most (but not all) of vitamins and minerals of concern, and others we evaluated
Thank you!