

Overview of Impact of Flour Fortification with Iron

Althea M Grant, PhD

**Chief, Epidemiology and Surveillance Branch, Division
of Blood Disorders, NCBDDD, CDC**

Ankara, Turkey

12 June 2012

The findings and conclusions in this presentation are those of the author and do not necessarily represent the views of the Centers for Disease Control and Prevention



Outline

- **Overview of physiological functions of iron and consequences of iron deficiency**
- **Iron Fortification:**
 - **Forms of iron used ,types of foods fortified, and amount of iron needed**
- **Impact of flour fortification with the iron**
 - **Countries that fortify wheat flour with iron**
 - **Impact of iron fortification on iron deficiency**

Iron

❑ Essential micronutrient

- Hemoglobin needed to carry oxygen through the blood
- Cellular proteins
 - Myoglobin
 - Cytochromes – energy-producing redox reactions
 - Others proteins – DNA synthesis, cell division
 - Connective tissues, neurotransmitters, and immune system

❑ Most contained in red blood cells and recycled

❑ No mechanism for excretion

❑ Loss only through blood loss or sloughing

- Normally lose 1 mg per day
- Menstruation – 10 mg per cycle (more for heavy bleeders)
- Blood donation 250mg

Iron Absorption

- ❑ **Iron levels controlled by absorption**
- ❑ **Absorption is ~ 5-10% of dietary intake**
- ❑ **Heme iron - animal sources (hemoglobin, myoglobin)**
 - Form best absorbed
 - Mechanism of absorption not well understood
- ❑ **All other iron (nonheme)**
 - Absorption is affected by:
 - ↓ Precipitation in pH >7.0
 - ↓ Tannins and phytates
 - ↑ Vitamin C

Iron Deficiency Anemia

- ❑ **Leading cause of anemia**
- ❑ **Most prevalent nutritional deficiency in the world**
 - affecting approximately 2 billion persons
- ❑ **Effects**
 - Delay normal infant motor function or mental function
 - During pregnancy can increase risk preterm births
 - Fatigue that impairs the ability to do physical work in adults
 - Iron deficiency may also affect memory or other mental function in teens

What Leads to Iron Deficiency Anemia?

Increased Iron Needs

1. Rapid growth
2. Pregnancy
3. Blood loss
 - Heavy menstrual periods
 - Frequent blood donation
 - Some stomach and intestinal conditions (food sensitivity, hookworms)

Decreased Iron Intake and Absorption

1. Lack of heme iron sources in the diet (e.g., vegetarian diets)
2. Low absorption
 - Taking antacids or other medications

Who is most at risk of iron deficiency anemia ?

❑ **Young children**

- 6 month to 3 yrs
- Babies who were born early or small.
- Babies given cow's milk before age 12 months.
- Some breastfed babies
- Formula-fed babies who do not get iron-fortified formulas.
- Children aged 1–5 years who get more than 24 ounces of cow, goat, or soymilk per day.
- Children who have special health needs, for example, children with chronic infections or restricted diets.

❑ **Pregnant women.**

❑ **Adolescent girls and women of childbearing**

- Menstruation

How much dietary iron do we need ?

Recommended Dietary Allowance (RDA) for iron by age and sex.

Age/Group	Life Stage	Iron (mg/day)
Infants	0–6 months	0.27*
	7–12 months	11
Children	1–3 years	7
	4–8 years	10
Males	9–13 years	8
	14–18 years	11
	19 or over	8
Females	9–13 years	8
	14–18 years	15
	19–50 years	18
	51 and over years	8
Pregnant Women	14 and over	27
Lactating Women	14–18 years	10
	19–30 years	9
	31–50 years	9

Strategies to Reduce Iron Deficiency

- ❑ Iron supplementation with pharmacological doses
- ❑ Iron fortification of industrially manufactured food
- ❑ Dietary diversification to improve iron bioavailability
- ❑ Selective plant breeding or genetic engineering to increase the iron content or to reduce absorption inhibitors in dietary staples

Hurrell, Richard, Peter Ranum, Saskia de Pee, Ralf Biebinger, Lena Hulthen, Quentin Johnson, and Sean Lynch. 2010. "Revised recommendations for iron fortification of wheat flour and an evaluation of the expected impact of current national wheat flour fortification programs." *Food and nutrition bulletin* 31 (1 Suppl) (March): S7-21. <http://www.ncbi.nlm.nih.gov/pubmed/20629349>.

Types of Food Fortified with Iron

- ❑ **Flour**
 - Wheat
 - Corn
- ❑ **Rice**
- ❑ **Seasoning Powder**
- ❑ **Salt**
- ❑ **Sugar**
- ❑ **Curry Powder**
- ❑ **Fish Sauce**

Hurrell, Richard, Peter Ranum, Saskia de Pee, Ralf Biebinger, Lena Hulthen, Quentin Johnson, and Sean Lynch. 2010. "Revised recommendations for iron fortification of wheat flour and an evaluation of the expected impact of current national wheat flour fortification programs." *Food and nutrition bulletin* 31 (1 Suppl) (March): S7-21. <http://www.ncbi.nlm.nih.gov/pubmed/20629349>.

Daily fortification iron consumption required for a satisfactory impact (results from controlled field trials)

- ❑ Sodium iron EDTA: 4.6 mg**
- ❑ Ferrous sulfate or ferrous fumarate: 7.1 mg**
- ❑ Electrolytic iron (elemental iron): 10 mg**
- ❑ Ferric pyrophosphate: 10 mg**
- ❑ Reduced iron (elemental iron): no significant impact**

Hurrell, Richard, Peter Ranum, Saskia de Pee, Ralf Biebinger, Lena Hulthen, Quentin Johnson, and Sean Lynch. 2010. "Revised recommendations for iron fortification of wheat flour and an evaluation of the expected impact of current national wheat flour fortification programs." *Food and nutrition bulletin* 31 (1 Suppl) (March): S7-21. <http://www.ncbi.nlm.nih.gov/pubmed/20629349>.

When to Consider National or Regional Wheat Fortification with Iron

- ❑ **Iron deficiency anemia > 5%**

Goal:

- ❑ **Decrease prevalence of iron deficiency < 10% and iron deficiency anemia < 5% by 2-3 years after start of fortification**

Hurrell, Richard, Peter Ranum, Saskia de Pee, Ralf Biebinger, Lena Hulthen, Quentin Johnson, and Sean Lynch. 2010. "Revised recommendations for iron fortification of wheat flour and an evaluation of the expected impact of current national wheat flour fortification programs." *Food and nutrition bulletin* 31 (1 Suppl) (March): S7-21. <http://www.ncbi.nlm.nih.gov/pubmed/20629349>.

Determining appropriate level of fortification to reduce iron deficiency

- ❑ The chemical form of the fortification iron being added**
- ❑ The level of addition**
- ❑ The vehicle consumption rate**

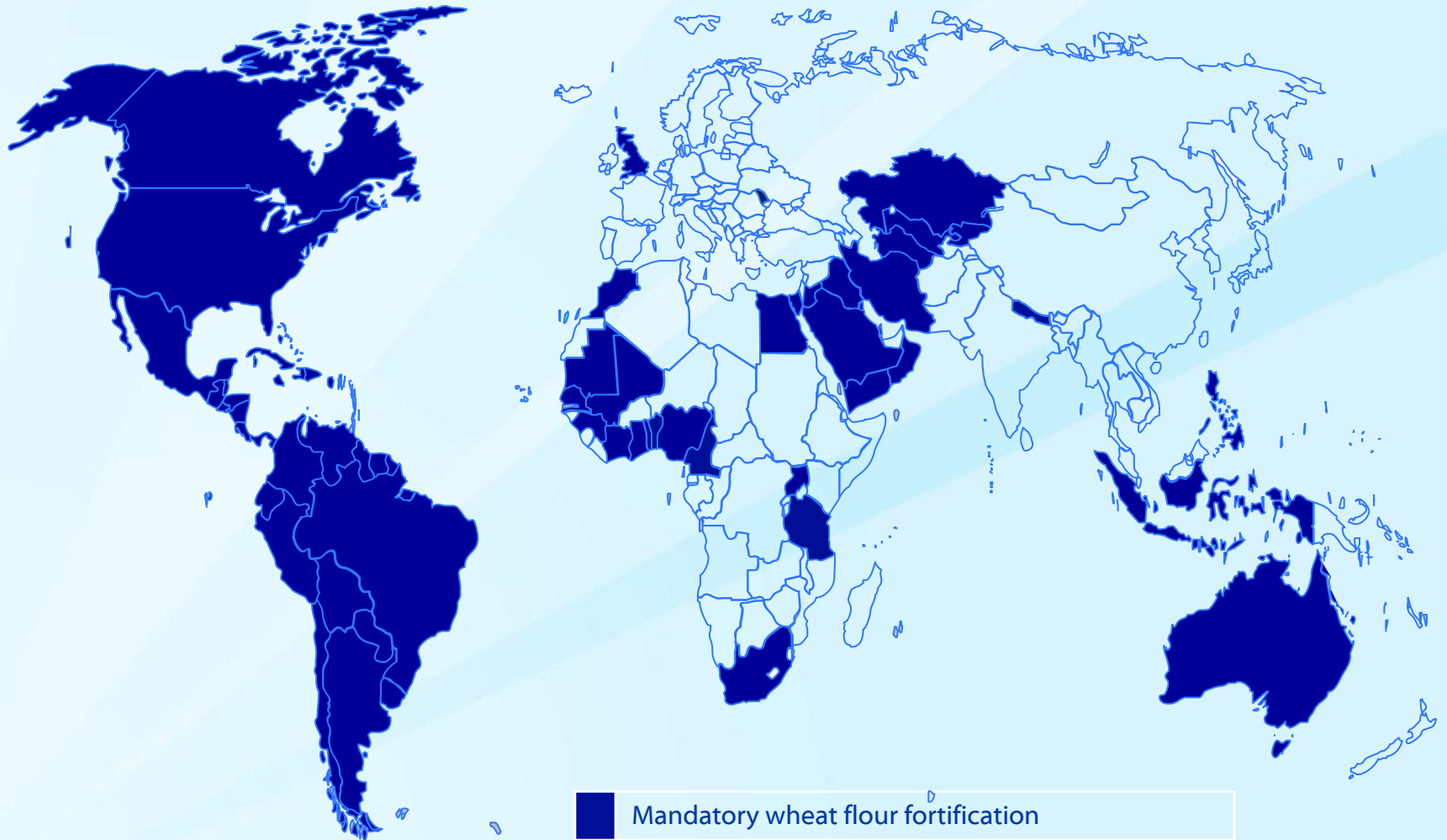
Recommended Wheat Flour Fortification Levels Based on Trials

Flour Consumption (g/day)	NaFeEDTA (ppm)	Ferrous sulfate or ferrous fumarate (ppm)	Electrolyte iron powder (ppm)
>300	15	20	40
150-300	20	30	60
75-149	40	60	Not recommended
<75	40	60	Not recommended

Hurrell, Richard, Peter Ranum, Saskia de Pee, Ralf Biebinger, Lena Hulthen, Quentin Johnson, and Sean Lynch. 2010. "Revised recommendations for iron fortification of wheat flour and an evaluation of the expected impact of current national wheat flour fortification programs." *Food and nutrition bulletin* 31 (1 Suppl) (March): S7-21. <http://www.ncbi.nlm.nih.gov/pubmed/20629349>.

Wheat Flour Fortification Status

May 2012: Fortifying with at least iron and/or folic acid



Effectiveness of Wheat Fortification Program

- ❑ **Only 9 national programs could expect to have the desired nutritional impact**
 - Millers do not follow Cuernavaca or WHO guidelines
 - Fortification with atomized and hydrogen-reduced elemental iron powders
 - Use of fortification levels that are too low based on consumption patterns

Hurrell, Richard, Peter Ranum, Saskia de Pee, Ralf Biebinger, Lena Hulthen, Quentin Johnson, and Sean Lynch. 2010. "Revised recommendations for iron fortification of wheat flour and an evaluation of the expected impact of current national wheat flour fortification programs." *Food and nutrition bulletin* 31 (1 Suppl) (March): S7-21. <http://www.ncbi.nlm.nih.gov/pubmed/20629349>.

Summary and Recommendations

- ❑ **Iron fortification is efficacious for reducing iron-deficiency (based on trials)**
- ❑ **In order for iron fortification to be effective**
 - Using recommended iron compounds
 - Use adequate concentration based on consumption patterns

Thank You

For more information please contact Centers for Disease Control and Prevention

1600 Clifton Road NE, Atlanta, GA 30333
Telephone, 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
E-mail: cdcinfo@cdc.gov Web: www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

