

A blue-tinted photograph of the ETH Zurich building, featuring a large dome and arched windows, with mountains in the background.

Micro Nutrient Forum - Beijing May 2009

Development of the recommendations for the iron fortification of wheat flour

Richard Hurrell

Laboratory for Human Nutrition

Institute of Food Science and Nutrition



Iron working group: Development of new recommendations for flour fortification

Aims:

1. Evaluate to what extent the flour industry is following the Cuernavaca Guidelines
2. Adjust the Cuernavaca Guidelines based on recently published efficacy studies and more realistic flour intake patterns

Summary of Cuernavaca Guidelines (FFI/CDC 2004)

★ For low extraction wheat flour use in preference:

Dried ferrous sulfate or ferrous fumarate

flour consumption: > 200 g/person/day add 30 ppm iron
< 200 g/person/day add 45 ppm iron

alternatively use electrolytic iron

flour consumption: > 200 g/person/day add 60 ppm iron
< 200 g/person/day add 90 ppm iron

★ For low extraction wheat flour in unfermented food and high extraction wheat flour use in preference **NaFeEDTA** at 30ppm.

★ These recommendations increase daily iron intake by 6 mg for ferrous sulfate and ferrous fumarate, and NaFeEDTA, and 12 mg for electrolytic iron (200 g flour/d).

Defining the iron concentration needed in flour to eliminate ID in at risk groups

★ Cuernavaca Guidelines (2004):

Recommended levels were based on current practice in milling industry, historically based on restoration and potential negative sensory changes. Levels were adjusted for flour consumption and iron bioavailability. Iron compounds were selected based largely on human iron absorption studies but also animal and in vitro studies.

★ WHO methodology (2006):

Ideally individual countries should use this methodology. Provide the difference between requirement and intake.

★ Atlanta (2008):

Iron levels and compounds based on minimum amounts of iron shown to improve iron status of young women in efficacy studies, levels adjusted for flour consumption and iron bioavailability.

Iron working group procedure

Develop new recommendations

- ★ Review all iron efficacy and effectiveness trials in cereals and condiments.
- ★ Estimate for different iron compounds the minimum daily amount of Fe that improved iron status.
- ★ Develop new recommendations by providing this Fe in different amounts of daily flour consumption.

Evaluate impact of wheat flour programs that are in place

- ★ Compare iron compounds and levels used in current national programmes with those recommended at Cuernavaca.
- ★ Based on flour intake data and fortification practice, calculate amount of additional daily iron provided by fortification.
- ★ Compare additional daily iron intake with that found to be efficacious in published efficacy studies.

Evaluation of iron efficacy and effectiveness studies: inclusion/exclusion criteria

- ★ All studies in adult women, adolescents and children which monitor Hb or iron status parameters
- ★ No infant studies
- ★ All food vehicles
- ★ Studies > 5 months duration
- ★ Randomized controlled studies with adequate description of methodology and clearly defined iron compounds
- ★ Studies with added ascorbic acid were excluded, studies with other added micronutrients were included

Minimum daily amount of iron in different compounds which have been demonstrated to be efficacious in women

★ Ferrous sulfate	4 studies, min. 7.1 mg (Kuwait)
NaFeEDTA	9 studies min. 4.6 mg (Guatemala)
Electrolytic iron	6 studies, min. 10 mg (Thailand)

★ Evidence-based values from studies with a demonstrated decrease in prevalence of ID/IDA

Recommended levels for low extraction wheat flour

Flour consumption g/d	NaFeEDTA	Ferrous sulphate/ferrous fumarate(encaps.)	Electrolytic iron powder
> 300 (350)	15	20	40
150-300 (225)	20	30	60
75 - 150(112.5)	40	60	Not recommended
< 75 (50)	40★	60	Not recommended

★ > 150 g/d: sensory problems should be avoidable

★ < 150 g/d: ferrous fumarate/encapsulated compounds should have acceptable sensory properties; other compounds need testing

★ < 75 g flour/day cannot be fortified to cover iron requirements

Order of preference

For low extraction wheat flours:

Use NaFeEDTA, ferrous sulfate or ferrous fumarate

- ★ More studies support NaFeEDTA than ferrous sulfate
- ★ No efficacy studies with ferrous fumarate

As a 2nd preference use electrolytic iron

- ★ Less studies support the use of electrolytic iron than other recommended compounds

Iron fortification of high extraction wheat flour

★ NaFeEDTA is the recommended compound

Flour consumption g/d	NaFeEDTA
--------------------------	----------

>300 (350)	15
------------	----

150-300 (225)	20
---------------	----

75 - 150(112.5)	40
-----------------	----

< 75 (50)	40
-----------	----

Recommend the same levels as for low extraction wheat flour on the assumption that EDTA will increase the absorption of native iron

Impact of current national wheat flour iron fortification programs

- ★ Only 9/78 programs judged likely to have significant positive effect on iron status at the national level.
(Argentina, Chile, Egypt, Jordan, Lebanon, Turkmenistan, Uruguay)
- ★ Many countries (47) do not specify iron compounds and millers use poorly bioavailable H-reduced and atomized elemental iron powders.
- ★ Some countries specify non-recommended iron powders, have too low fortification levels, poor coverage or low flour consumption.
- ★ We need strategies to encourage governments to modify legislation and millers to follow guidelines as:

We know how to fortify flour to eliminate ID