



Impact of Flour Fortification With Other Essential Micronutrients



Flour Fortification Initiative
A Public-Private-Civic Investment in Each Nation

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Addressing Micronutrient Deficiencies Through Flour Fortification
In the CEE/CIS Region

Other micronutrients

- **Vitamins:**

B Group:

Thiamine (vitamin B1),

Riboflavin (vitamin B2)

Niacin (vitamin B3)

Pyridoxine (vitamin B6)

Vitamin D

- **Minerals:**

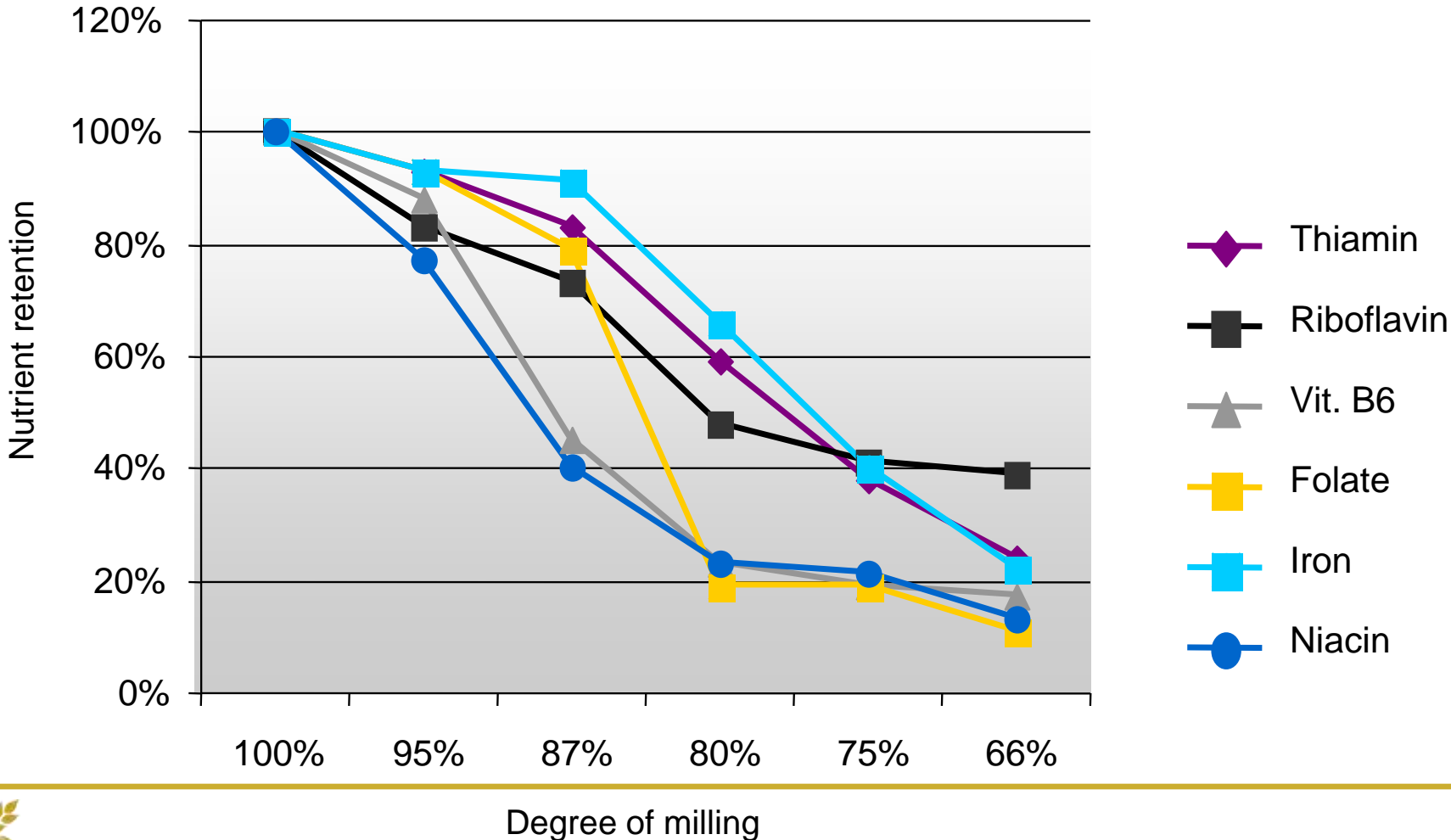
Calcium,

Magnesium



Flour Milling Depletes Whole Grain of Natural Vitamins & Minerals

Loss of vitamins and minerals during milling of wheat



B VITAMANS



Consequences of deficiency:

- Thiamine (vitamin B1)
 - Beriberi
- Riboflavin (vitamin B2)
 - Non-specific signs in mild deficiency including weakness, mouth pain, itching
 - Severe deficiency causes dermatitis, angular stomatitis, brain dysfunction & anaemia
- Niacin (vitamin B3)
 - Pellagra, oral lesions, vomiting, diarrhoea, neurological signs
- Pyridoxine (vitamin B6)
 - Non-specific: neurological disorders, skin changes, possibly anaemia



B group vitamin fortification:

- Thiamine (B1), Riboflavin (B2), Niacin B3 added as restitution or restoration to whole grain wheat levels.
- Some or all Mandatory in the Americas, Indonesia, Jordan, Central Asian countries, Morocco, Nigeria, Saudi Arabia, South Africa, UK.
- In Canada, USA and UK historically added to address B group deficiencies considered to be public health problems



Premix specification: To meet US/Canada regulations

Ingredient:	Amount per kg Flour:
• Thiamine B1	5.2 mg
• Riboflavin B2	3.6 mg
• Niacin B3	42 mg
• Folic Acid	1.5 mg
• Iron , electro	35 mg
• Dosage	160 g per MT flour
• Premix Cost	\$10.80 per kg (Nov 2009)
• Fortification cost	\$1.73 per MT



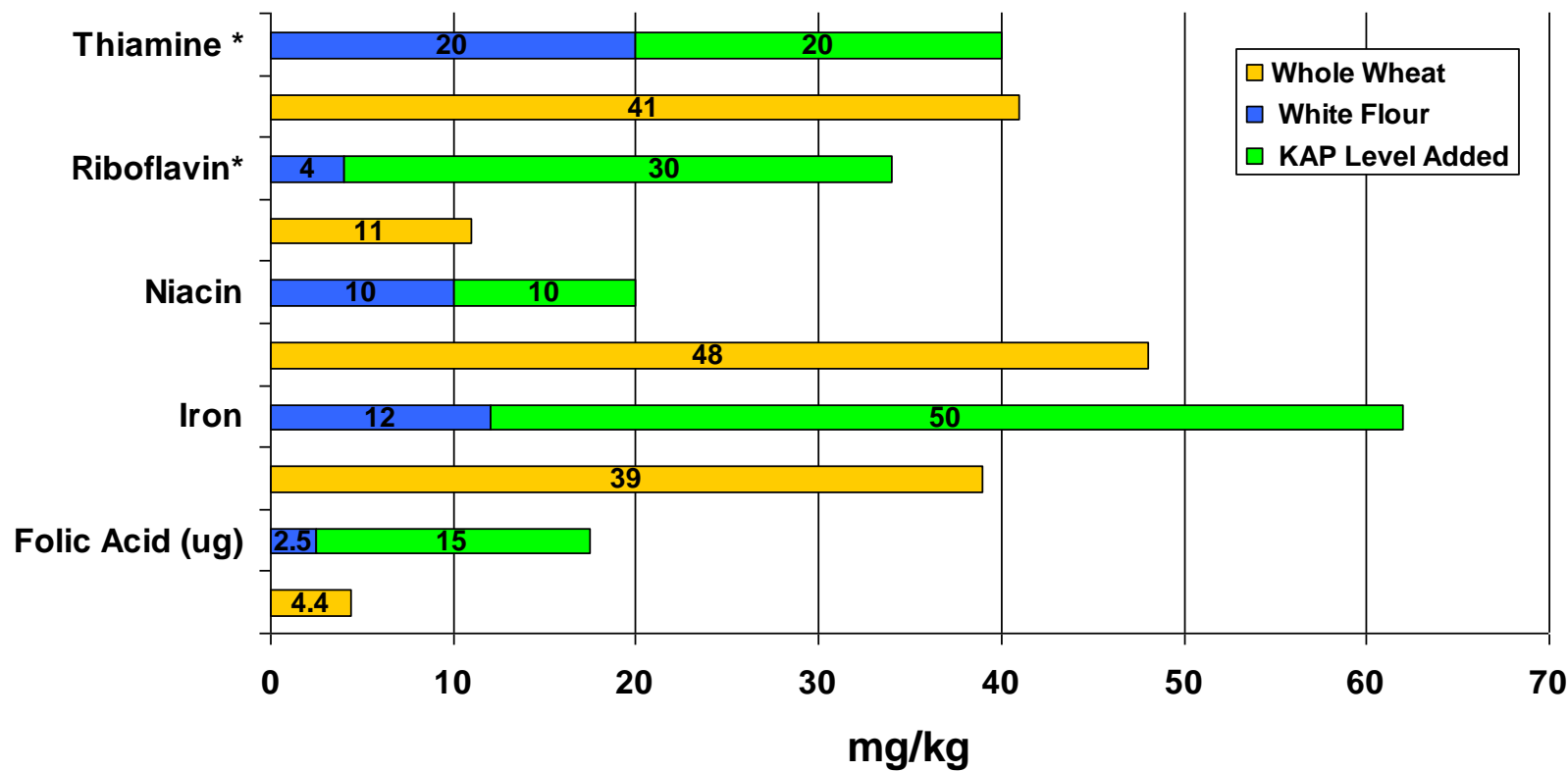
Premixes and Standards

Standards in US and Canada are set based on addition plus natural levels e.g.:

Ingredient	Added	Natural	Total	Standard
• B1	5.2	1.3	6.5	6.3
• B2	4.0	0.4	4.4	4.0
• B3	46	12	58	52
• FA	1.5	0.2	1.7	1.5
• Iron	38	11	49	44



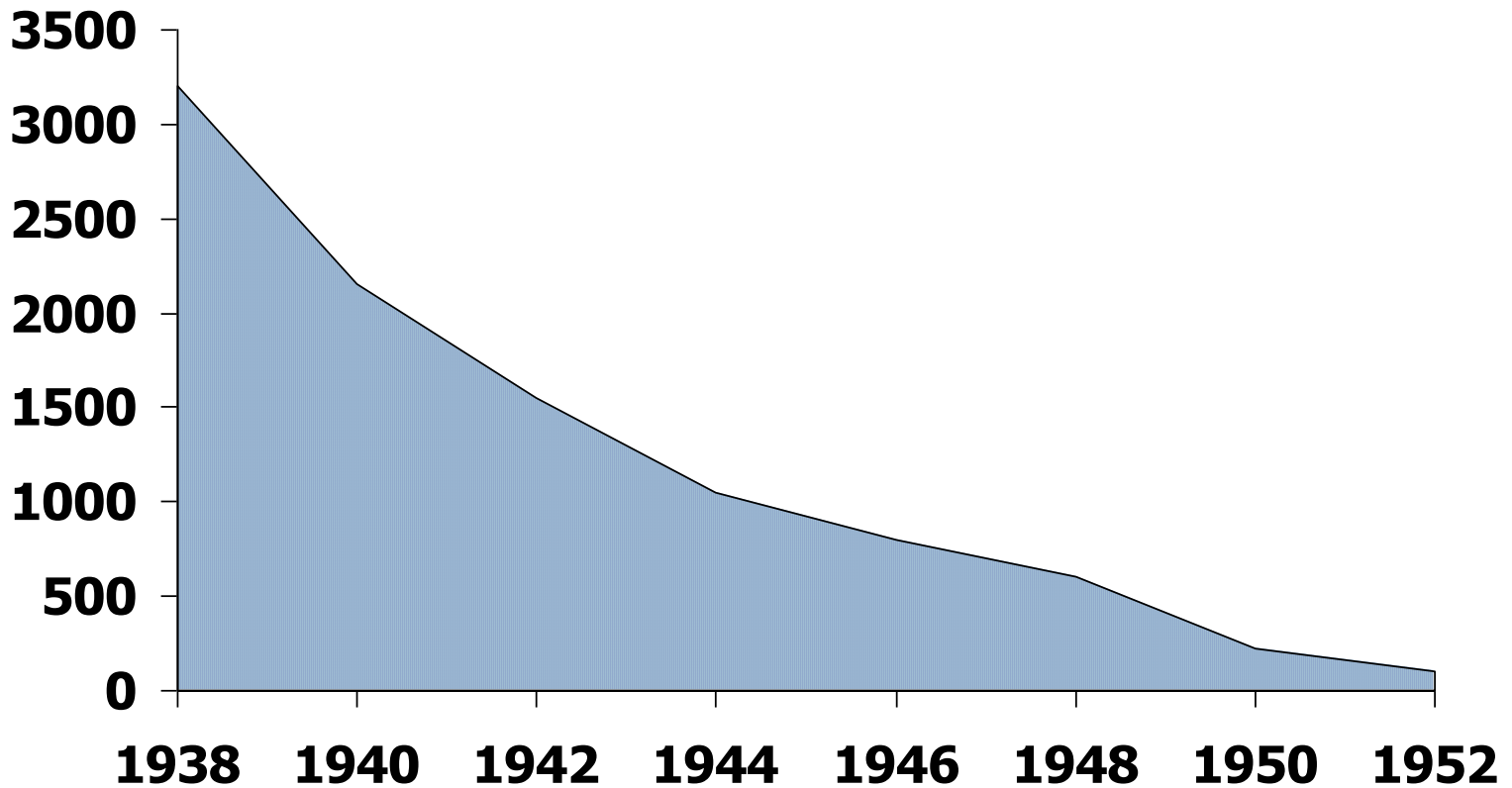
Central Asia: KAP Complex Restores Nutritional Profile of White Flour



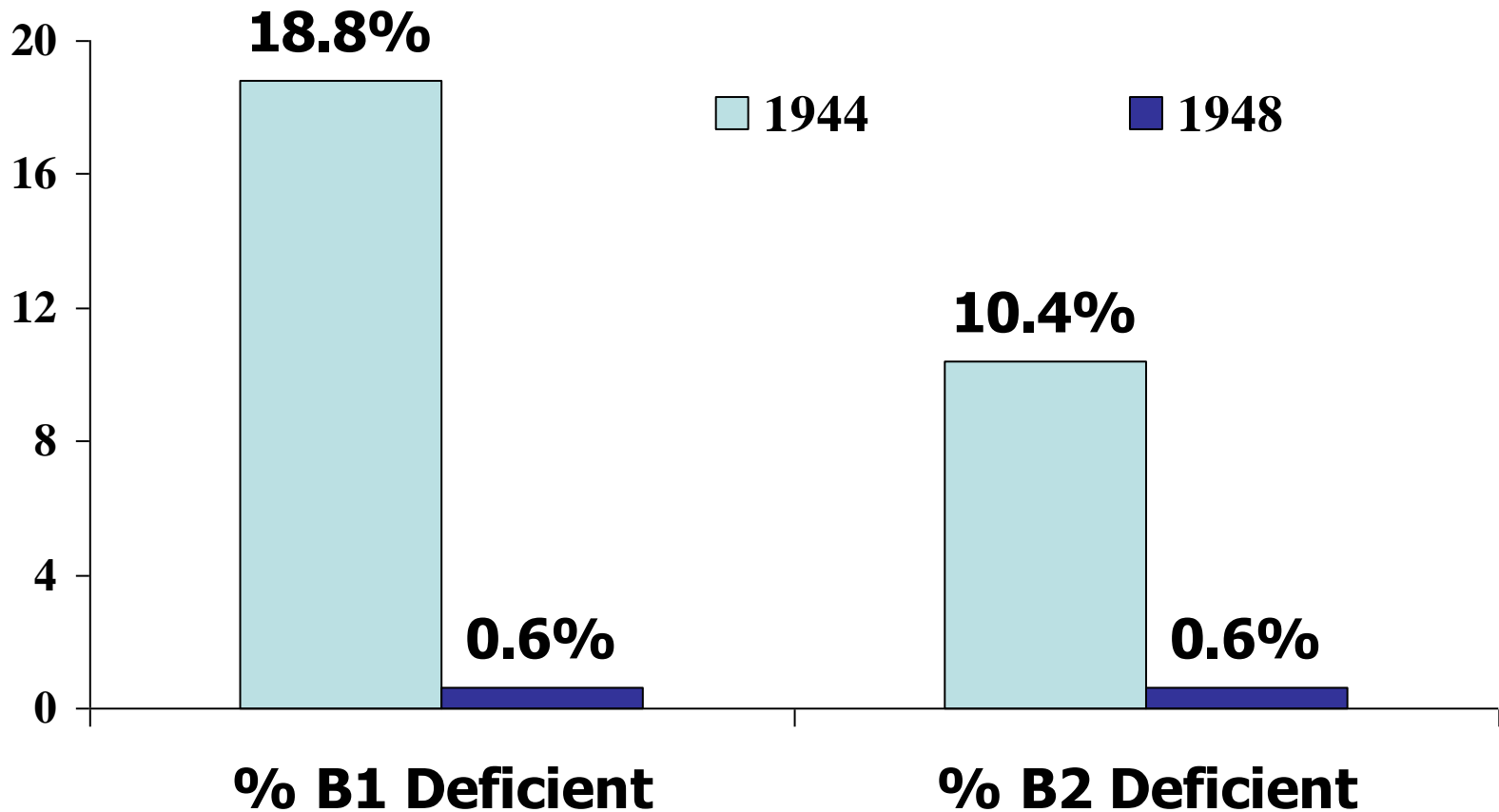
* Factor x 10



Flour Fortification in the USA Deaths from Niacin Deficiency by Year



Flour Fortification in Canada (started in 1944) Vitamin B Deficiencies



VITAMIN D



Vitamin D

- Deficiency results in rickets and osteomalacia
- Vit D enhances calcium absorption. Deficiency contributes to osteoporosis
- Recent studies implicate vitamin D deficiency in some cancers, diabetes and heart disease
- May be implicated in multiple sclerosis which is more prevalent in northern countries (Canada, Scotland, Germany) and far south countries (New Zealand)
- Jordan research shows high levels of rickets in children and women
- Other Middle East countries such as Egypt investigating vitamin D deficiencies



Vitamin D

- Known as the “sunshine” vitamin as it is metabolized in the skin layers in the presence of sunlight.
- Exists in liquid fat D2 and D3 forms (cholecalciferol)
- If there is limited sunlight exposure Vitamin D requirements for adolescents is 5000 IU per day (Vitamin D Council*)

www.vitamindcouncil.org



Vitamin D fortification options

- Vegetable oil: D plus vitamin A
- Margarine: 530 IU per kg plus vitamin A
- Milk products: D at 400 IU per liter plus A
- Wheat flour: Feasible
- Maize flour: Feasible

Powder form used for flour fortification is 10% spray dried form containing 100,000 IU per gram



Flour fortification experience

- UK: Vitamin D was added together with calcium in 1930s. Later, it was removed from flour and put into milk
- Jordan: Vitamin D (550 IU per kg flour) included in the flour fortification premix since June 2009
- Gulf Countries Council Wheat Flour Standard GS194 includes vitamin D at 550 IU per kg
- Used in many complementary food fortification products such as corn-soy blend



Vitamin D Fortification Cost

- Adding 550 IU per kg (14 parts per billion) of flour adds \$0.04-0.05 per MT of flour
- The form used in flour fortification is Vitamin D₃



MINERALS



Consequences of deficiency:

- Calcium
 - Decreased bone mineralization, osteoporosis
- Magnesium
 - Deficiency uncommon. Possible heart rhythm disturbances, neurological problems



Minerals

- Calcium: Mandatory in the UK, voluntary in Canada and USA at 1400 mg per kg flour (1400 ppm)
- Magnesium: Voluntary in Canada at 1900 mg per kg flour (1900 ppm)



For additional information, visit:

<http://www.ffinetwork.org/plan/standards.html>

www.ffinetwork.org



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