



Effects of Micronutrient Fortification in Tortilla Processing

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Why add micronutrients to food?



The Ideal

A healthy diet includes whole foods from a variety of sources



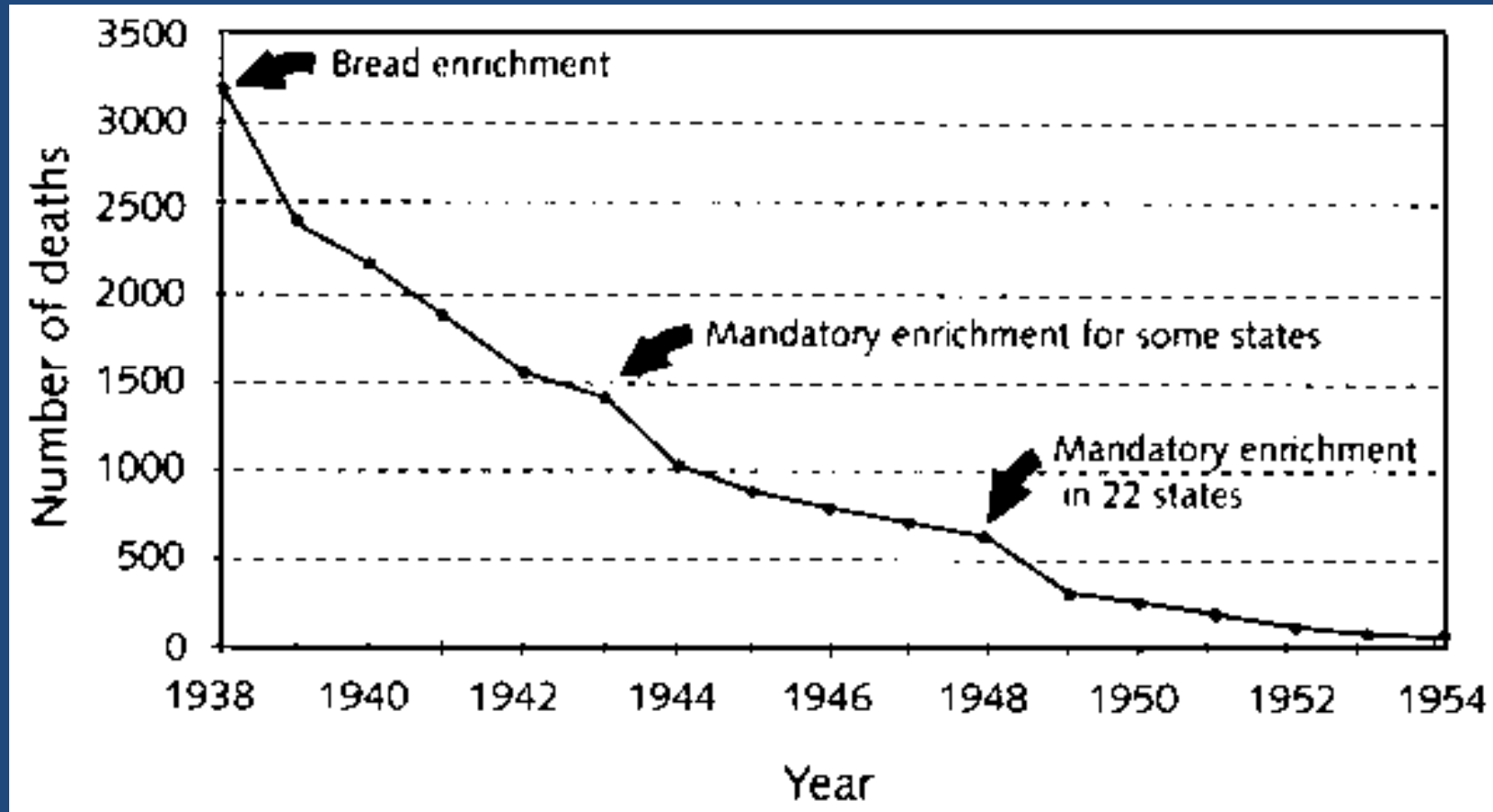
The Reality

Culture/lifestyle, taste-preference
and economics also affect our diet

Micronutrient Fortification

Micronutrient fortification
is proven to be effective!

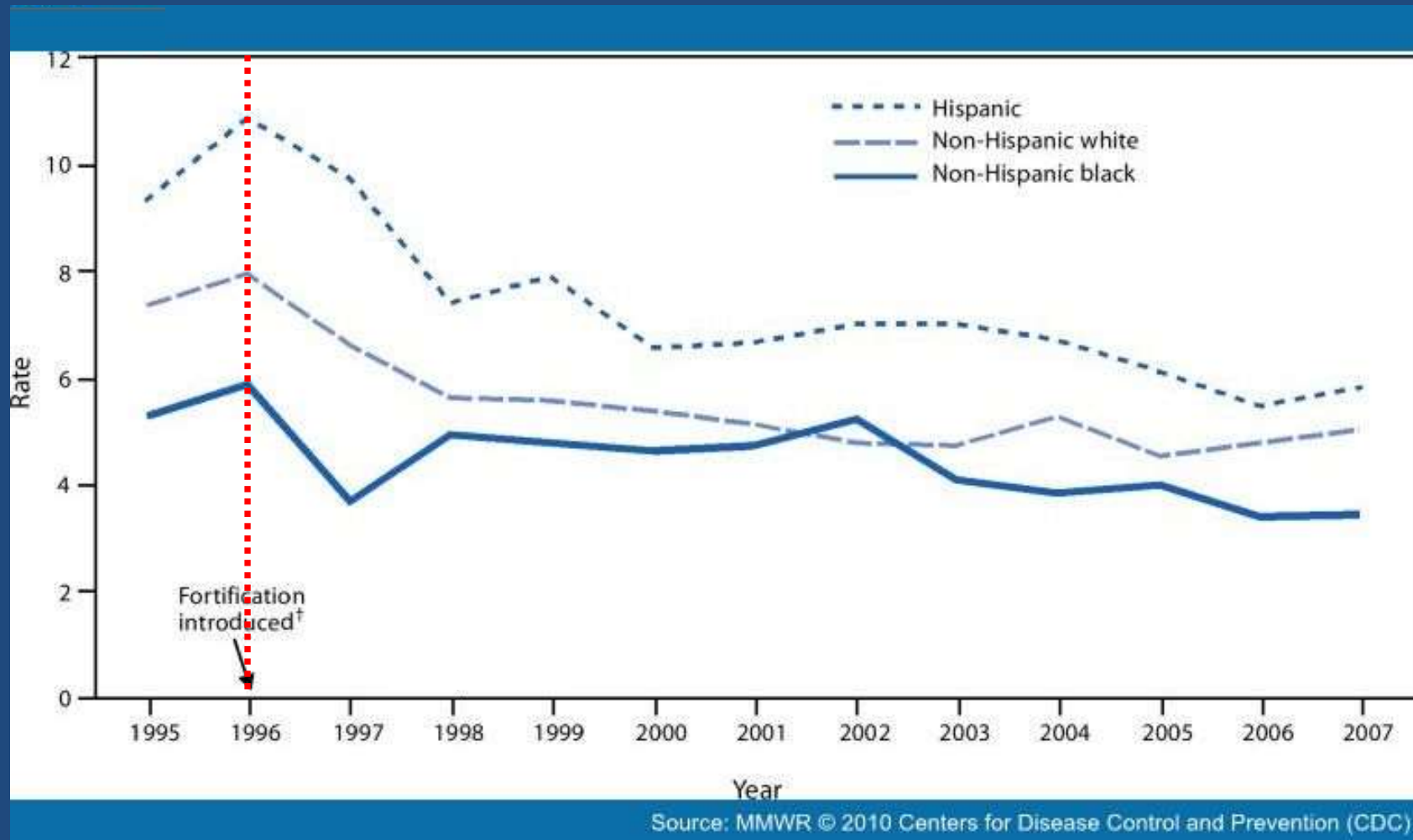
Effect of enrichment of flour on deaths from pellagra in the United States, 1938-1954



Source: Miller, D.F. 1978. Food Prod Dev 12(4): 30-8.

Effect of folic acid fortification of flour on neural tube related birth defects in the United States, 1995-2007

Defect rates per
10,000 population



Source: <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5931a2.htm>

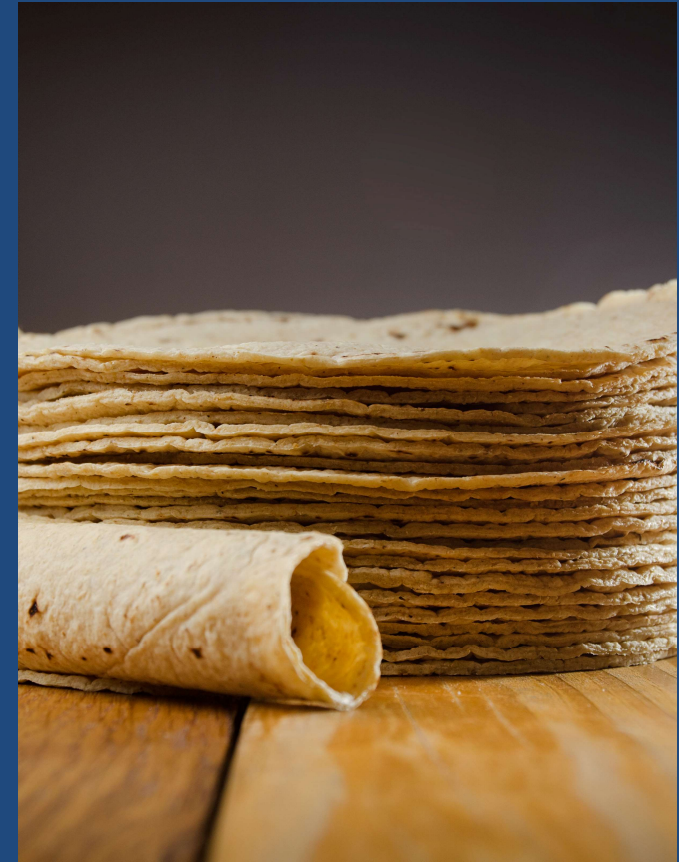
The Hope

**Fortification will
support a healthier
future for our
children.**



Micronutrient Fortification

Micronutrient fortification
is effective, but ...



What About Corn Masa Products?

Possible Concerns With Corn Masa Product Fortification

- How do we add vitamins/minerals?
- Will nutrients affect product quality?
- Are nutrients stable?
- Is the cost reasonable?
- What about the label?

Micronutrient Fortification

How do we add vitamins
and minerals?

Corn Tortilla Manufacturing

1. Produced from fortified CMF



Corn Tortilla Manufacturing

2. Produced from fresh nixtamal



**Need mechanism and process for
adding vitamins/minerals consistently:**

Powdered premix dosifier

OR

Liquid premix pump

Powder Dosifier



Measuring Masa Flow Rate





Adjust dosifier flow rate
to match mill flow rate
(1 g premix/Kg masa)

Powder Dosing Configuration



Powder Dosing Configuration



Powder Dosing Configuration



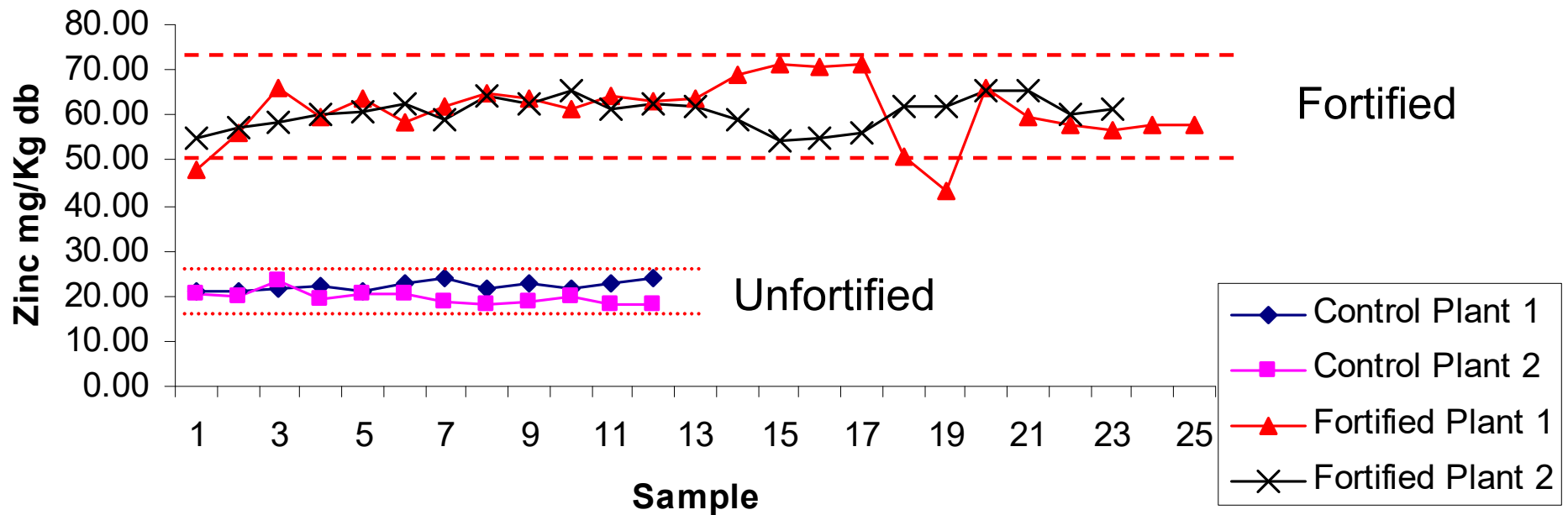
Liquid Dosing Configuration



Liquid Dosing Configuration



Powder Dosing Consistency



Tortillas sampled every 10 min during two (control) and four (fortified) 60 min production runs on separate days in two plants (Dashed lines indicate 95% confidence limits)

Micronutrient Fortification

Do added vitamins and minerals affect product quality?

Affect on Tortilla Quality

Consumer Test – U.S. w/ Mexican Natives
No Significant Differences Between Samples

	Ct	Mp	Nutrients Added:
Overall Liking	7.4 ^a	7.3 ^a	Iron (fumarate) Zinc Folic acid Niacin Riboflavin Thiamin
Color	7.6 ^a	7.5 ^a	
Aroma	7.5 ^a	7.4 ^a	
Flavor	7.3 ^a	7.2 ^a	
Texture	7.4 ^a	7.2 ^a	

Affect on Tortilla Quality

Consumer Test – Mexico D.F. No Significant Differences Between Samples

	Control	Fortified
Overall Liking	7.37 ^{a*}	7.31 ^a
Color	7.65 ^a	7.25 ^a
Aroma	7.47 ^a	7.45 ^a
Flavor	7.29 ^a	7.20 ^a
Texture	7.41 ^a	7.25 ^a

* - Same letters indicate no significant difference between samples

Appearance: Need Right Iron Source



Unfortified

Electrolytic
Iron



Micronutrient Fortification

Are the vitamins and
minerals stable?

Micronutrient Stability During Processing

Micronutrient	% Retention ^a
Thiamin	95%
Riboflavin	89%
Niacin	99%
Folic Acid	72%
Zinc	92%
Iron (2 X)	94%

^aTheoretical value calculated by adding premix amount to levels in unfortified tortillas

Micronutrient Fortification

What about the cost?

Fortification only costs a few cents per pound; with the cost of the micronutrient premix usually falling between \$2 and \$5 per metric ton of flour.

Micronutrient Fortification

What about the label?

New Hurdles of the Modern Age

“Clean” Labels and
“Chemophobia”

What is Clean Label?

- Consumers looking for clean label want ingredients that are:
 - “familiar”
 - “short and simple”
 - “no artificial ingredients”
 - “not chemical-sounding”
 - “kitchen cupboard ingredients” only

(Asioli et al., 2017)

Not “Nasty” Chemicals Like These:

- Thiamine Mononitrate
- Riboflavin
- Folic acid
- Niacin
- Ferrous sulfate or Reduced Iron

Solution: More Informative Ingredient Declarations

- Corn Masa Flour, Niacin (a B Vitamin), Reduced Iron (source of iron), Thiamine Mononitrate (Vitamin B1), Riboflavin (Vitamin B2), Folic Acid (a B Vitamin)
- Corn Masa Flour, Vitamins and Minerals (Niacin, Reduced Iron, Thiamine Mononitrate, Riboflavin, Folic Acid)

Conclusions

- Added vitamins are cost-effective, stable, and show insignificant effects on product quality
- Use of fortified CMF requires no significant changes
- Additional processing changes will be required for fortification of fresh nixtamal, but it is feasible

Questions ?