

Zinc fortification of cereal flours: current recommendations and research needs

Zinc Working Group

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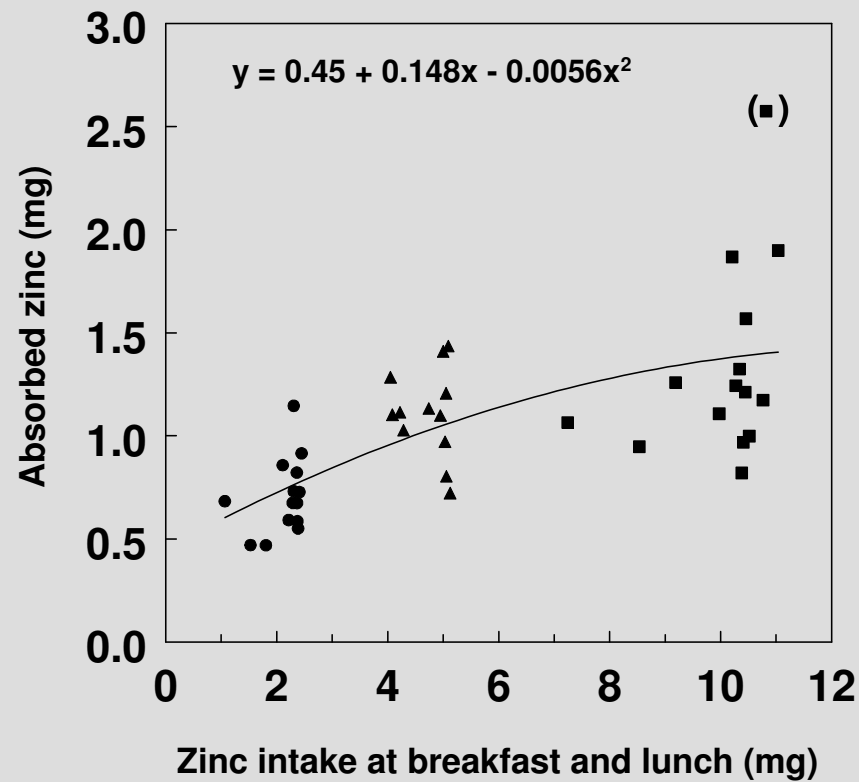
Overview of presentation

- Background – Zinc and human health
- Impact of zinc fortification
 - Tracer studies of zinc absorption
 - Intervention trials
- Appropriate levels and forms of zinc fortification
 - Simulations of effects on TAZ
 - Chemical form of zinc
- Potential adverse effects
 - Sensory trials
 - Mineral absorption
- Summary of recommendations

Zinc and human health

- Zinc is required for normal immune function, physical growth, pregnancy outcome
- Deficiency results in increased diarrhea, pneumonia, and possibly malaria and other infections; reduced weight gain and linear growth; premature delivery

Total absorbed zinc by amount of zinc intake from fortified foods



López de Romaña et al. Am J Clin Nutr, 2005

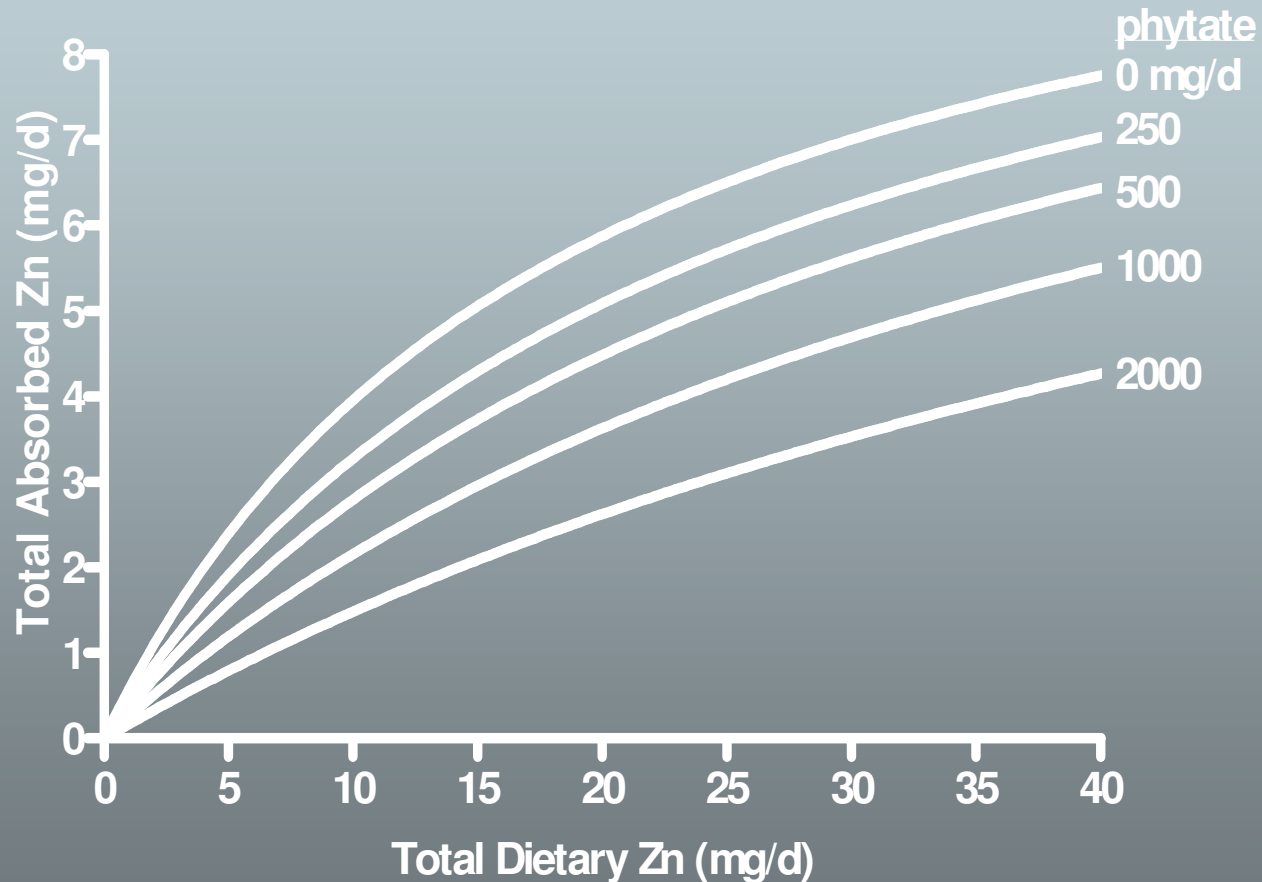
Impact of
fortification

Impact of zinc fortification of wheat flour* on mean serum zinc conc ($\mu\text{g}/\text{dL}$), China

Month of study	EDTA arm		Elemental iron arm	
	Control	EDTA iron + zinc	Control	Elem iron + zinc
0	73 \pm 25	75 \pm 27	73 \pm 16	72 \pm 17
12	72 \pm 24	75 \pm 28	72 \pm 14	74 \pm 18
24	72 \pm 19	78\pm16	74 \pm 13	76\pm12
36	71 \pm 19	79\pm16	75 \pm 13	78\pm11

* Wheat fortified with 25 mg/kg flour as zinc oxide (Huo Junsheng, China CDC, unpublished)

Factors affecting zinc absorption: dietary zinc and phytate



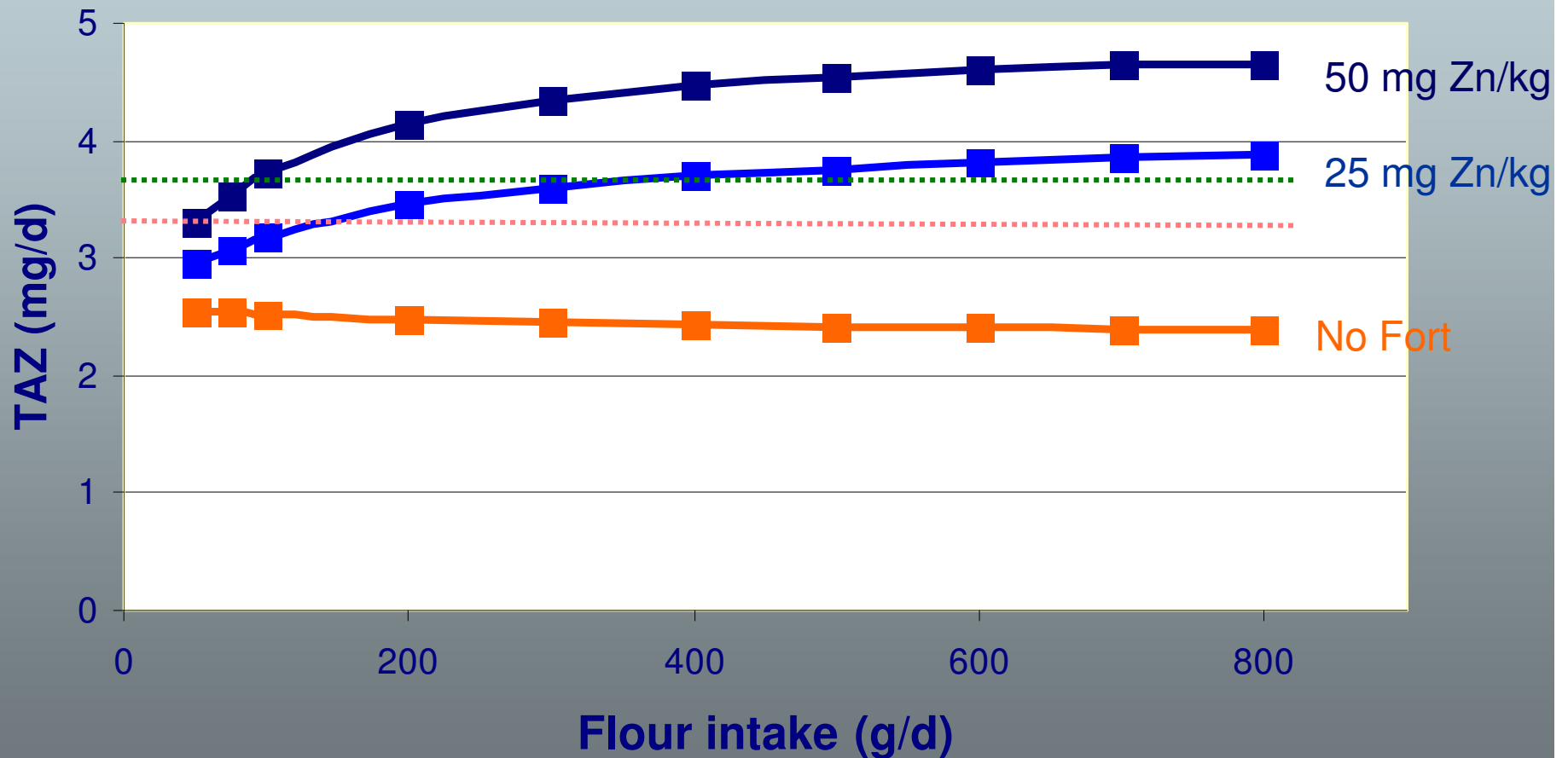
Data derived from: Miller LV et al, J Nutr 2007

Level of
fortification

Estimation of zinc absorption from zinc-fortified cereal flour

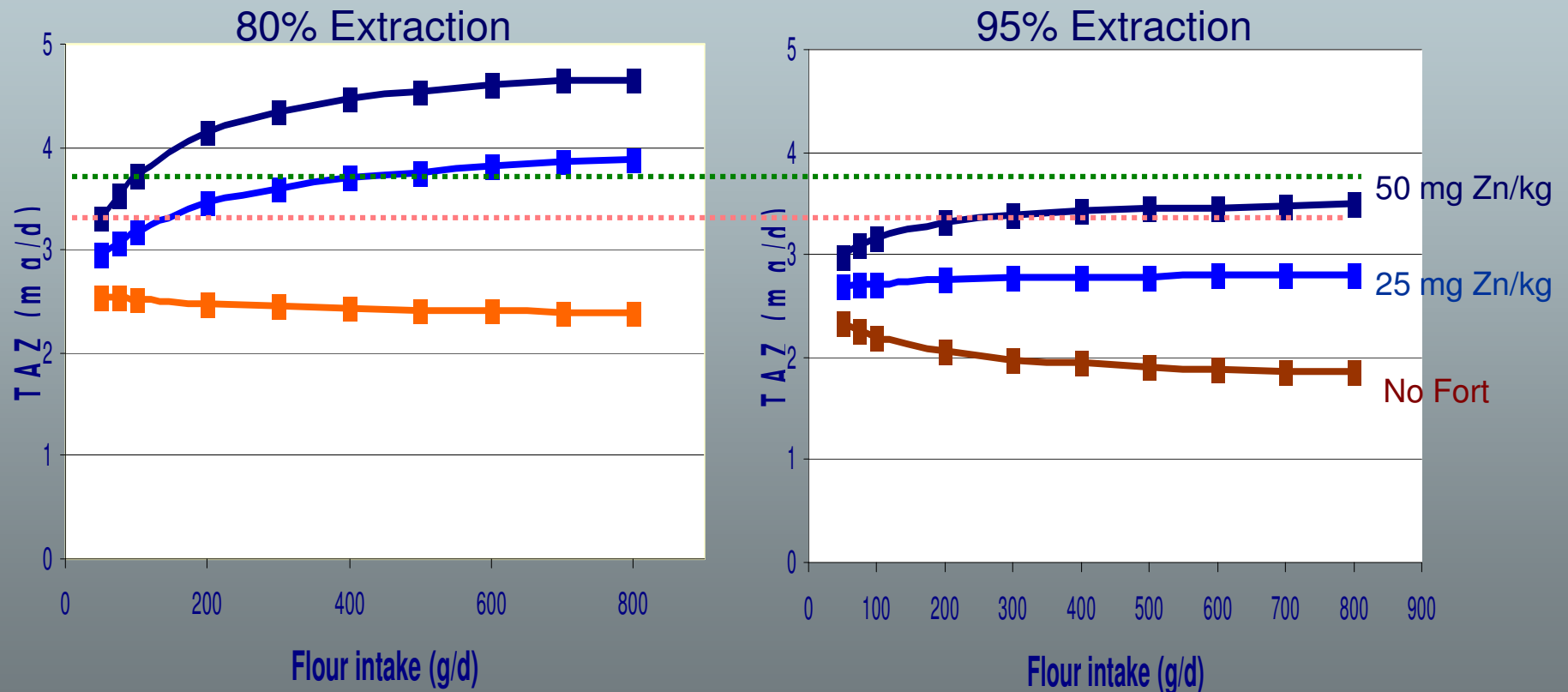
- Zinc absorption can be estimated by applying Miller equation
- Information needed:
 - Amount of flour consumed
 - Level of extraction of flour (hence zinc and phytate content of flour)
 - Level of zinc fortification
 - Amounts of zinc and phytate consumed from the rest of the diet

Estimated TAZ (mg/d) by amount of flour intake and level of zinc fortification, 80% extraction flour*



* Assumes 5 mg zinc and 0 mg phytate from non-flour food sources

Estimated TAZ (mg/d) by amount of flour intake and level of zinc fortification*



* Assumes 5 mg zinc and 0 mg phytate from non-flour food sources

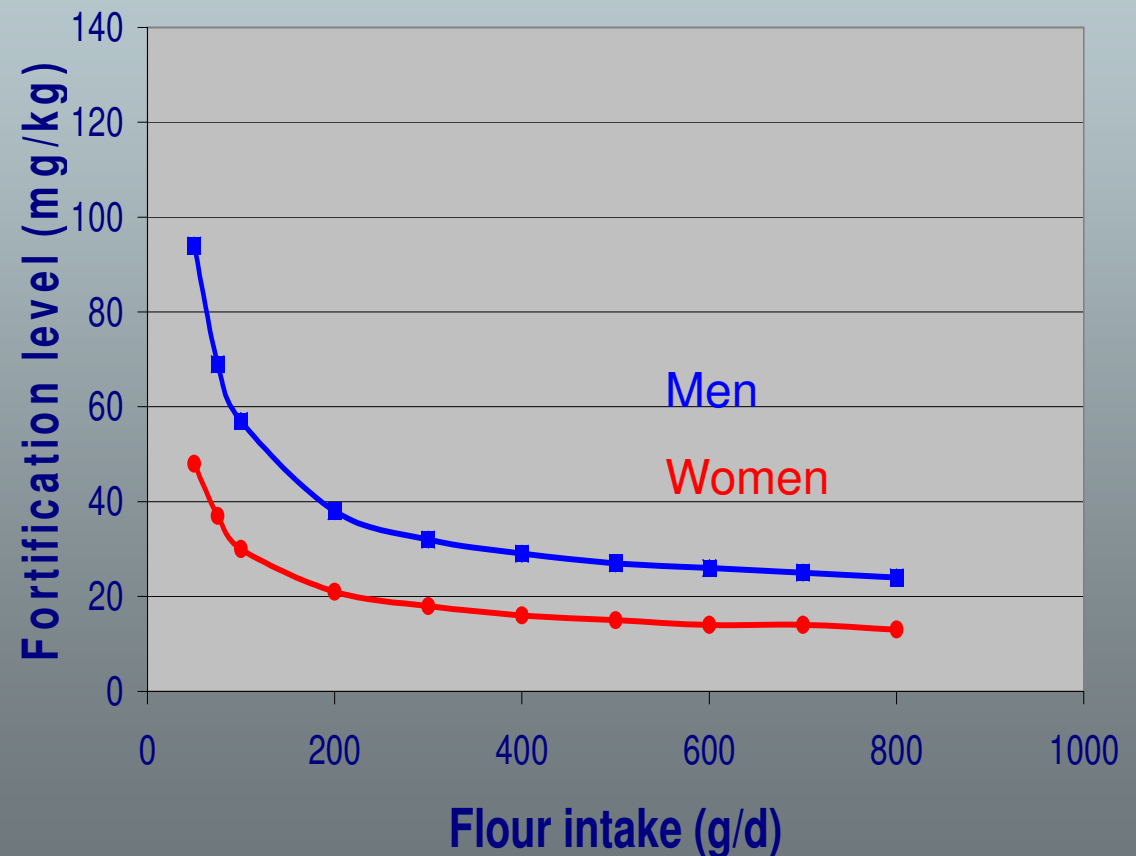
Simulations of effects of zinc fortification

- Flour intakes from 50-800 g/d
- Zinc and phytate contents of 80% and 95% extraction wheat flour
- Assumed Zn and phytate intakes from non-wheat sources
- Level of zinc fortification
- “TAZ UL”



Recommended level of zinc fortification of wheat flour (mg/kg), by amount of flour intake (80% extraction)*

Flour intake (g/d)	Men	Women
50	94	48
75	69	37
100	57	30
200	38	21
300	32	18
400	29	16
500	27	15
600	26	14
700	25	14
800	24	13



*Assumes 5 mg Zn, 0 mg phytate from other dietary sources; level of fortification that exceeds TAZ UL = 266 to 936 mg Zn/kg flour

Recommended levels of zinc fortification*

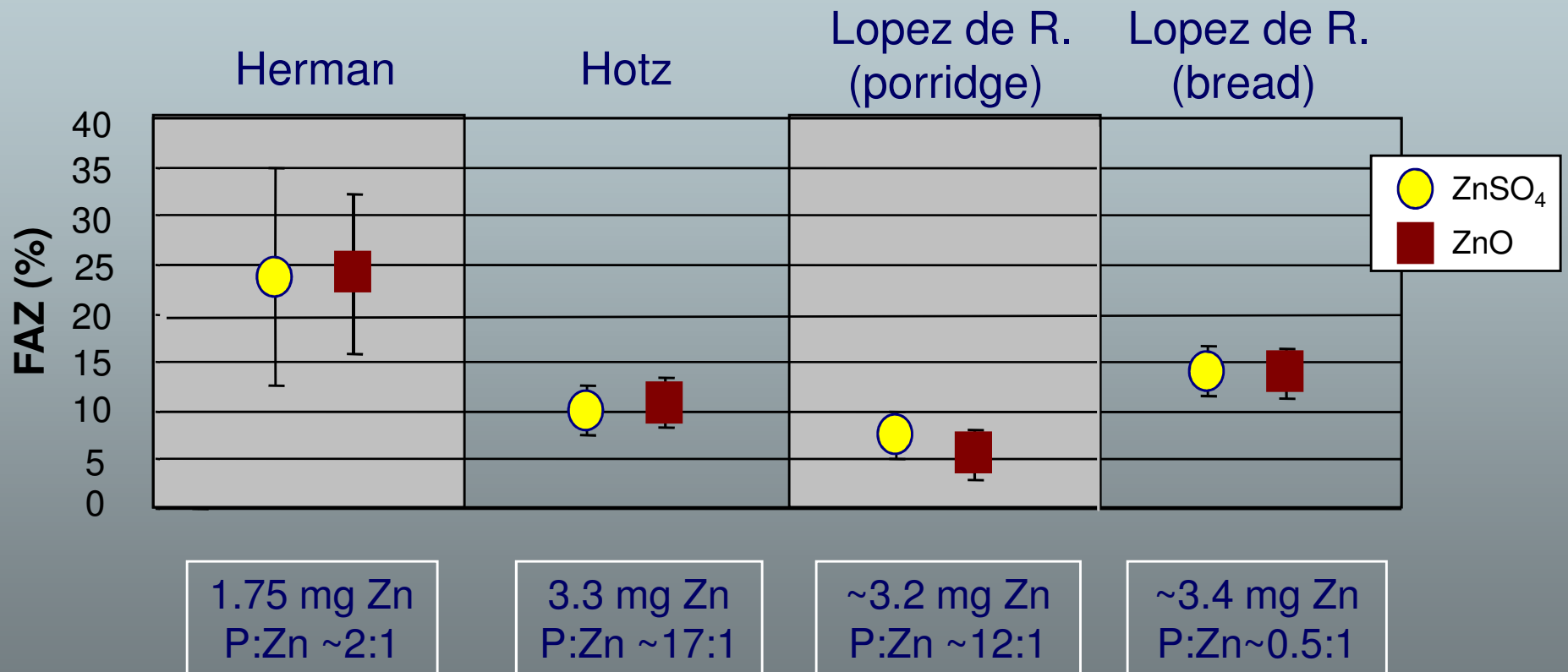
Flour intake (g/d)	80% extraction	95% extraction
50	95	135
75	70	110
100	55	100
200	40	80
300	30	75
400-500	30	70
500-800	25	70

* Assumes 5 mg zinc and 0 mg phytate intake from other sources



Recommendations

Fractional absorption of zinc (FAZ) from foods fortified with ZnO or ZnSO₄



No significant differences between ZnO and ZnSO₄

Conclusions

- Zinc fortification of cereal flour is a safe and effective, low-cost method to increase zinc intake, total absorbed zinc, and (in selected population groups) zinc status
- Zinc fortification should be included in flour fortification programs in countries with an elevated risk of zinc deficiency, if flour is consumed in sufficient amounts by target groups
- Zinc oxide is the fortificant of choice because of cost
- The appropriate level of zinc fortification depends on the amount of flour consumption, the degree of flour extraction, and the usual dietary intake of zinc and phytate

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SUPPLEMENT

*International Zinc Nutrition Consultative Group
Technical Document #2*

SYSTEMATIC REVIEWS OF ZINC INTERVENTION STRATEGIES

Kenneth H. Brown and Sonja Y. Hess, guest editors

Advances in zinc nutrition and health

Preventive zinc supplementation in children

Therapeutic zinc supplementation in children

Zinc supplementation during pregnancy and lactation

Zinc fortification

Dietary diversification or modification to enhance zinc intakes

Zinc intake through breastmilk

Improving zinc status through biofortification

Conclusions and mainstreaming zinc interventions

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Thank you!

