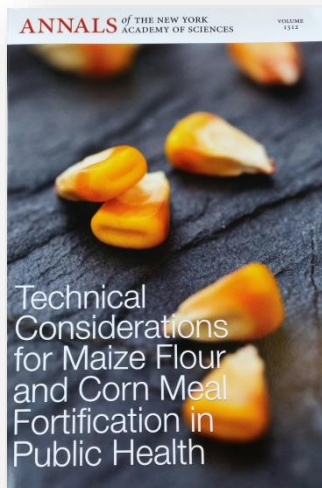


Technical considerations for maize flour and corn meal fortification in public health: a joint consultation



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Flours fortification

The World Health Organization is updating several evidence-informed guidelines for the fortification of staple foods as a public health intervention, including the fortification of maize flour and corn meal with iron and other micronutrients.

Flours fortification

It is now recognized that there is much more variability in maize flour processing than in wheat flour and the same principles that apply for wheat flour fortification may not necessarily apply for maize flour fortification.

Technical meeting

- WHO in collaboration with the Sackler Institute for Nutrition Science and the Flour Fortification Initiative.
- Consultation: Technical considerations for maize flour and corn meal fortification in public health.
- New York City, April 8–9, 2013.



In preparation for the meeting

Background documents were commissioned to experts in food technology and nutrition science on several topics.

Systematic review: “Fortification of maize flour with iron for preventing anaemia and iron deficiency in populations”.

Meeting objective

To review the industrial and regulatory technical considerations in maize flour and corn meal fortification.



Meeting outcomes

1. Multi-sectoral discussion on food technology and regulatory aspects of fortification of maize flour and corn meal.
2. Research priorities for fortification of maize flour and corn meal.
3. Considerations for maize flour and corn meal fortification programme implementation: adoption and adaptation.



Topics covered

1. Different technologies used industrially for the production of maize flour and corn meal.
2. Consumption patterns of products made with maize flour and corn meal.
3. Current technologies used by the maize industry to fortify maize flour and key differences in technologies used to produce fortified maize flour and corn meal.
4. Stability of micronutrients in different products made with fortified maize flour and corn meal.
5. Bioavailability of potential micronutrients used in the fortification of maize flour and corn meal.



Topics covered

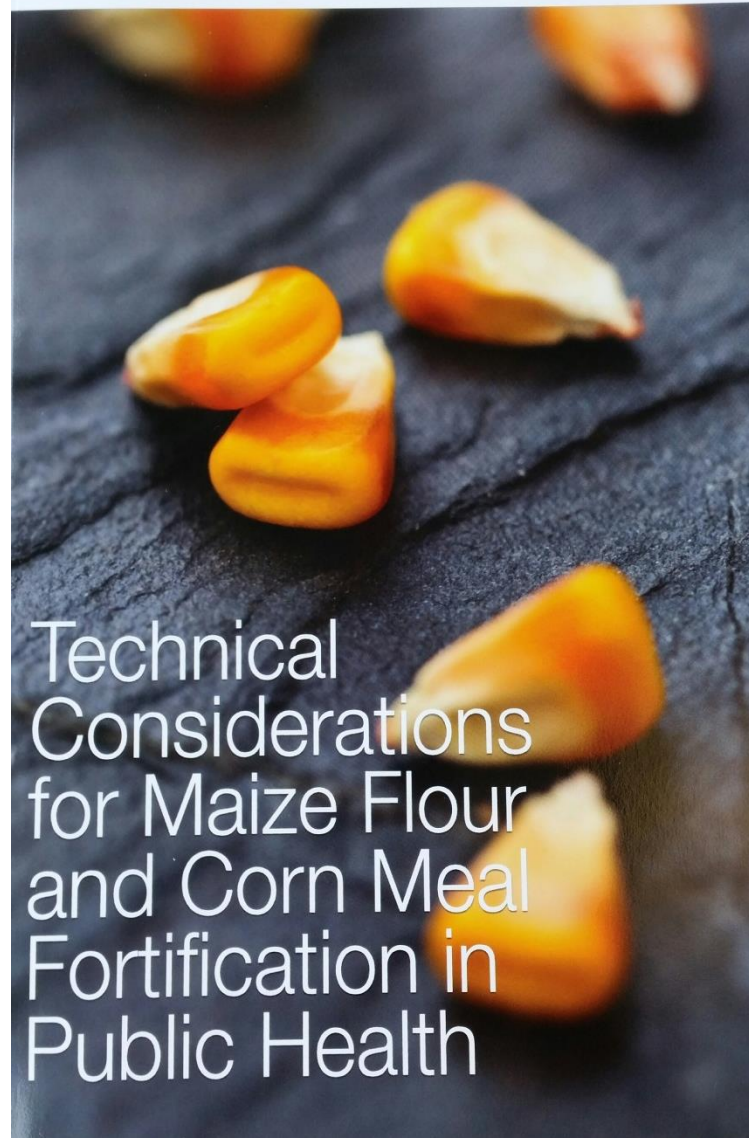
6. International experiences with fortified/enriched maize flour and corn meal, including norms and standards.
7. Determinants of equity in access to fortified maize flour and corn meal.
8. Economic analysis of maize production and fortification in developing nations
9. The impact of maize flour and corn meal fortification on nutrition and health outcomes.
10. Research priorities and programme implications for maize flour and corn meal fortification.

Meeting characteristics

- This was not a WHO normative meeting.
- The discussions provided inputs to the guideline development process on fortification of maize flour and corn meal as a public health strategy.
- Articles commissioned and presented in the meeting were published in a special issue of ANYAS.

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1312



Technical
Considerations
for Maize Flour
and Corn Meal
Fortification in
Public Health

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1312, 2014.



ANYAS issue

- The whole volume is devoted to maize
- Presentations from experts
- Discussions and research needs
- Discussions and conclusions from working groups



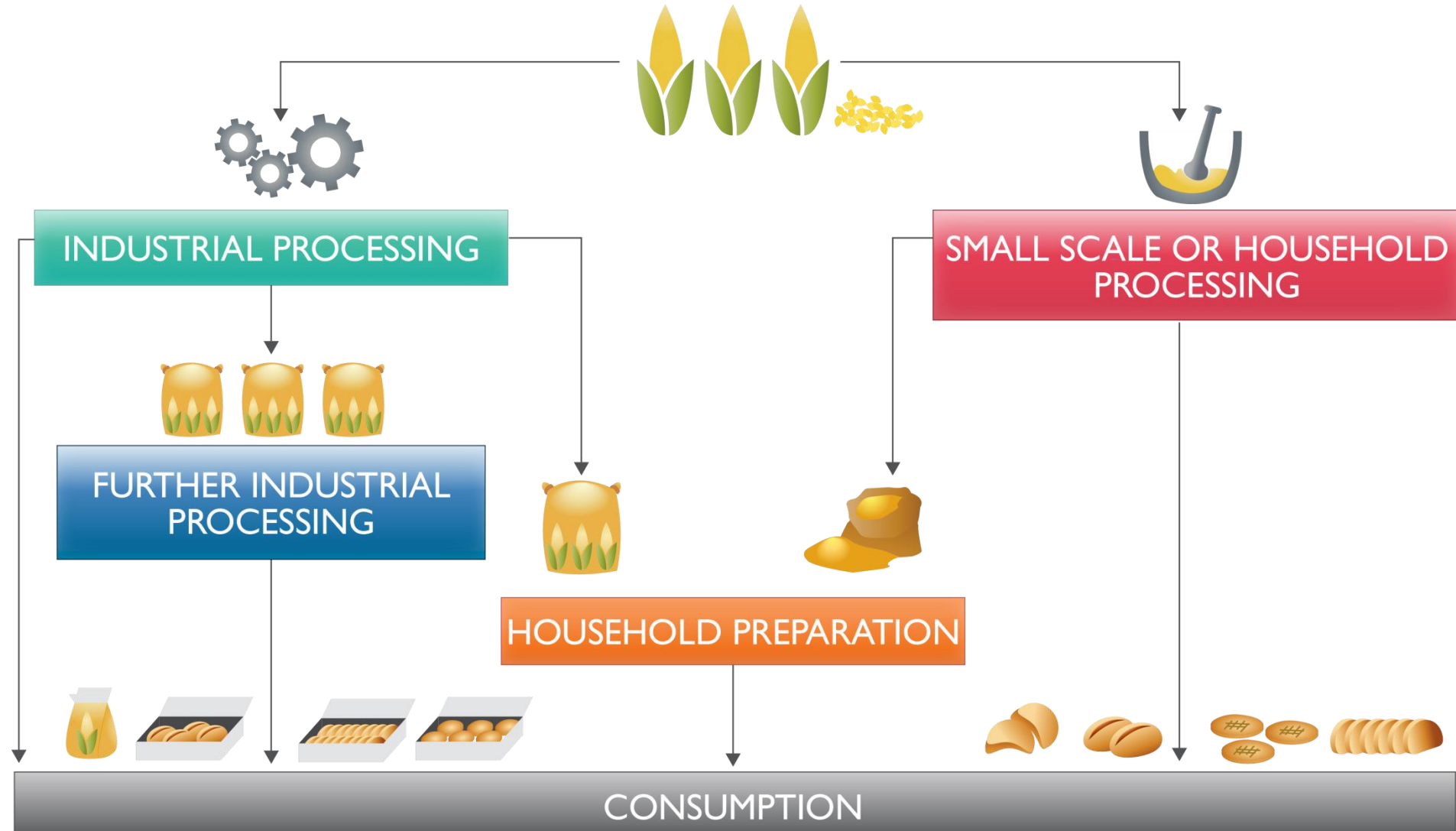
Highlights from presentations

- Important staple: In sub-Saharan Africa, some parts of Southeast Asia and Latin America, where iron deficiency is endemic, maize is a dietary staple for more than 200 million people.
- Fortification already in place: Voluntary fortification of maize with iron (and in some cases, other nutrients) has been introduced in Ghana, Malawi, and Mauritania while it is mandatory with at least iron in Brazil, Costa Rica, El Salvador, Kenya, Mexico, Nigeria, Rwanda, South Africa, Tanzania, Uganda, the United States, and Venezuela.

Highlights from presentations



Pathways of maize from field to consumer

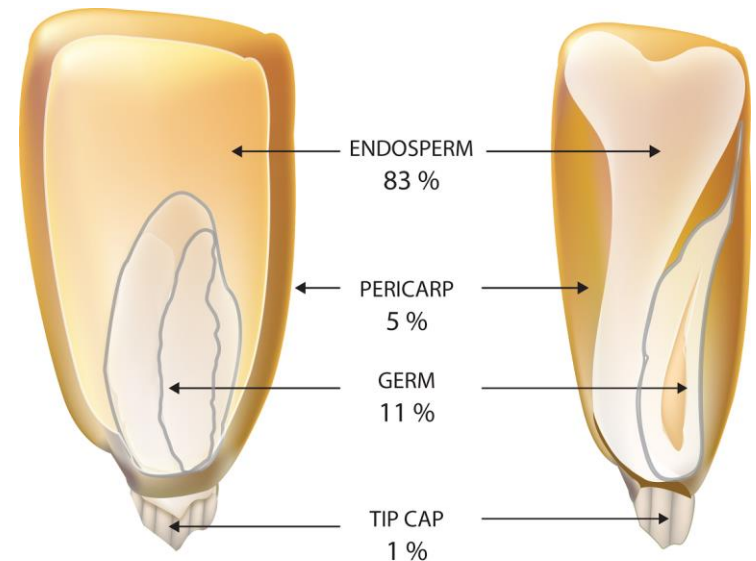


Processing and consumption

- Corn processing and consumption varies from country to country.
- Two basic categories of industrial processing for human consumption: wet and dry milling.

Wet milling of maize separates much of its nutrient content from the starch component.

This milling is not used for small-scale production or for direct consumption.



Dry milling

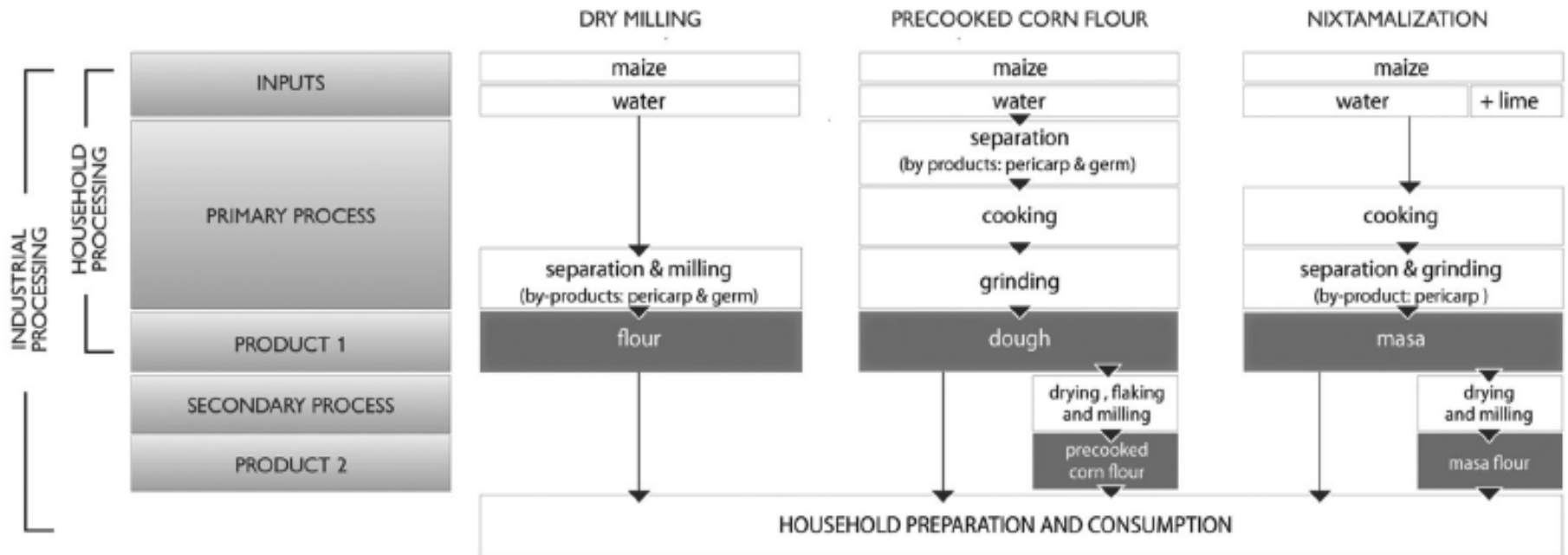


Figure 3. Schematics of dry-milling maize processing.

Definitions of degerminated maize products defined by particle size and fat content

	Particle size		Fat (%)
	Less than (μ)	Greater Than (μ)	
Grits	1400	600	0.8
Meal	600	300	1.8
Fine Meal	300	212	2.5
Flour	212		2.7

Various maize products consumed globally

Bread <ul style="list-style-type: none">- Flat, unleavened, unfermented- Fermented and/or leavened	Tortilla, arepa Pancakes, cornbread, hoe cake, blintzes
Porridges <ul style="list-style-type: none">- Fermented, unfermented	Atole, ogi, kenkei, ugali, ugi, edo, pap, maizena, posho, asidah
Steamed products	Tamales, couscous, rice-like products, chinese breads, dumplings, chengu
Beverages <ul style="list-style-type: none">- Alcoholic- Non-alcoholic	Koda, chicha, kafir beer, maize beer Mahewu, magou, chicha dulce
Snacks	Empanadas, chips, tostadas, popped corn, fritters



Micronutrient stability in flour

Significant losses in B vitamins (B1, B2, B3, B6, B9) occur during manufacturing, distribution, and cooking. Added minerals (e.g., iron, zinc, calcium) are generally retained.



Micronutrient bioavailability

- Non degermed maize has a high phytic acid content, which reduces the bioavailability of minerals such as iron and zinc.
- NaFeEDTA for corn masa flour and nondegermed maize. Ferrous fumarate and ferrous sulfate for degermed maize. Zinc oxide and zinc sulfate can be used for zinc fortification.
- Reduction of phytic acid using endogenous or exogenous phytase can improve bioavailability.
- Fortification of maize meal with folic acid could increase folic acid status in populations.
- Although limited studies on vitamin A bioavailability from vitamin A–fortified maize, a high bioavailability is likely with encapsulated retinyl acetate or retinyl palmitate.

Equity



- Incorporating an equity approach can contribute to increasing and guaranteeing access to fortified maize flour and corn meal. However, this approach is not yet common.
- For the 900 million people that consume maize as staple food, it is crucial that the scientists, program implementers, and policy makers understand and intervene in the barriers that prevent access to fortified maize flour and corn meal.

Economic feasibility



- Economic feasibility of maize fortification. Study in Zambia, Kenya and Uganda.
- The estimated incremental cost of maize flour fortification per metric ton varies from \$3.19 in Zambia to \$4.41 in Uganda. Assuming all incremental costs are passed onto the consumer, fortification in Zambia would result in at most a 0.9% increase in the price of maize flour, and would increase annual outlays of the average maize flour-consuming household by 0.2%.

Legislative framework



- The review of some national standards and regulations of fortified corn flour and maize meal indicated that the use of minimum contents or ranges of nutrients has caused confusion, misinterpretation, and conflict.
- During the discussion it was proposed that the additional content and the expected average nutrient content in a final product were recommended as the main parameters for quality control and enforcement.
- Variation in micronutrient contents should still be checked to ensure homogeneity but with adherence to clear procedures of sampling and testing, which should be part of the standards and regulations.

Other key aspects



- The importance and need for public-private partnerships to combine skills, expertise and other resources to achieve a common goal that is unattainable by independent action.
- Considering the number of small mills without fortification technology, to decide if fortification of maize flour is a feasible option for a particular country.

Working groups

- 5 multisectoral working groups met for 3 hours to discuss technical considerations for maize flour and corn meal fortification in public health programs.
- Plenary session to present the main considerations and conclusions of each group.





Highlights from working groups

- Need for clear, uniform definitions.
- Decisions on which nutrients and how much must be guided by:
 - the nutritional needs of the population,
 - the usual consumption profile of maize flour or corn meal that can be realistically fortified,
 - sensory and physical effects of the nutrient compounds on maize flour or corn meal products,
 - fortification of other food vehicles,
 - consumption of vitamin and mineral supplements,
 - and costs and
 - equity considerations
- Mandatory or voluntary?



Highlights from working groups

- Maize flour and corn meal fortification must be designed in the context of fortification (both voluntary and mandatory) of other food vehicles while assuring safety.
- Fortification programs of maize flour or corn meal could be expected to achieve a public health impact if mandated at the national level in countries where these are staples.



Highlights from working groups

- Monitoring and evaluation are essential components of any fortification program.
- The program evaluation has to go beyond biomarker assessment and include coverage and change in nutrient intake.



Barriers

- Weak or nonexistent enforcement of regulations.
- Inadequate nutrient levels or compounds.
- Low consumption of foods to be fortified.
- Poor manufacturing techniques and standards.
- Weak or nonexistent quality-control systems.
- Lack of continuity of efforts (sustainability).
- Changes in policies.



Research needs

- Bioavailability of iron compound mixes for use in the fortification of maize flour and corn meal produced with different technological processing.
- Bioavailability and stability of folic acid and vitamin A in maize flour and corn meal with different maize flour processing methods (i.e., nixtamalization).
- Impact of maize for biofuel production on food security and for sustainability of a maize flour and corn meal fortification program.
- Feasibility of small-scale fortification of maize flour and corn meal for public health programs.

Thank you



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