

Addressing Zinc Deficiency Through Wheat Flour Fortification in Cameroon

As part of an IZiNCG series of case studies on population-level zinc interventions, this brief describes the experience of Cameroon in implementing a zinc fortification program.

Highlights



- ▶ The 2009 National Micronutrient Survey confirmed that zinc deficiency among women and children was a public health problem.
- ▶ Wheat flour fortification was selected as the preferred strategy as part of an inter-agency effort to address hidden hunger.
- ▶ Fortification of all wheat flours with zinc, iron, vitamin B12 and folic acid was made mandatory in 2011.
- ▶ After one year, the prevalence of low plasma zinc concentrations dropped from 46.8% to 28.4% among children, and from 39.4% to 21.6% among women in two major cities.
- ▶ Coordination and monitoring are essential for the program's long-term success.

Cameroon 2009 National Micronutrient Survey:

THE POWER OF DATA

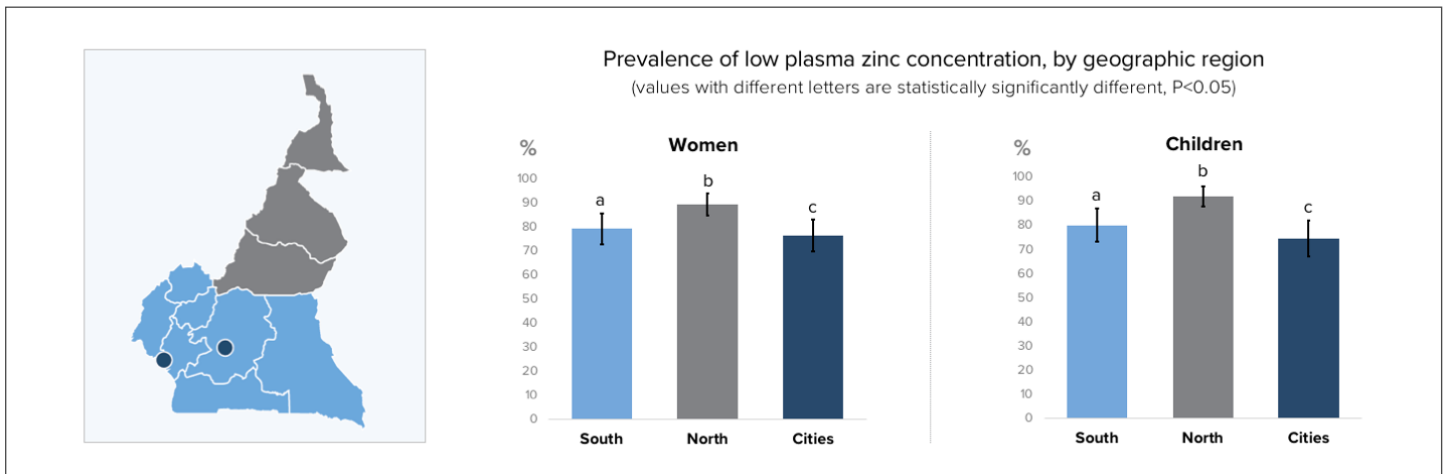
Prior to 2009, no information was available on the status of zinc or many other micronutrients in Cameroon. However, dietary patterns and a high prevalence of child stunting (35.3%¹ in 2004) suggested that zinc deficiency could be a public health problem. Specifically, diets were known to: 1) include only small amounts of animal products such as meat and shellfish, which are rich sources of bioavailable zinc, and 2) rely primarily on staple foods, such as grains and legumes, which contain zinc that is not well absorbed due to the high phytate content of these foods.

In 2009, the Ministry of Public Health, with the support of Helen Keller International (HKI), UNICEF, and University of California, Davis, conducted a National Micronutrient Survey among women and young children. The survey included assessment of micronutrient biomarkers and quantitative dietary intake using the Fortification Rapid Assessment Tool (FRAT)² and full 24-hour dietary recalls. The results revealed a very high prevalence of zinc deficiency among women and children throughout the country³. Nationally, more than 80% of both women and children had a low plasma zinc concentration. At a regional level, the prevalence ranged from 74% in Yaoundé/Douala to 92% in the North (**Figure 1**). Analysis of 24-hour dietary recall data showed that grains were the major source of zinc (30-44% by region) and only 24-27% of zinc came from animal products. Phytate:zinc molar ratios were also high (12-24), which would likely limit zinc absorption.

1. Demographic and Health Survey, 2004.

2. Fortification Rapid Assessment Tool; https://www.nutritionintl.org/content/user_files/2017/07/FRATguidelines2003_Nov_2008.pdf.

3. Engle-Stone R, Ndjebayi AO, Nankap M, Killilea DW, Brown KH. Stunting prevalence, plasma zinc concentrations, and dietary zinc intakes in a nationally representative sample suggest a high risk of zinc deficiency in women and young children in Cameroon. *J Nutr.* 2014. 144(3):382-91.

Figure 1. Prevalence of low plasma zinc concentration by geographic region among women and children in Cameroon.

Why Wheat Flour Fortification?



While the 2009 Micronutrient Survey was being planned, wheat flour was provisionally selected as a vehicle for fortification based on expected wheat flour consumption, technical feasibility, and availability of existing fortification standards^{4,5}. The survey confirmed that wheat flour consumption was common and frequent: more than 90% of women consumed wheat flour in the week preceding the survey, and the average frequency of consumption was 7.7 times per week, with frequency and amounts consumed being highest in urban areas.



Why is Zinc Important?



Reduces the risk of diarrhea and respiratory infections⁶.



Increases linear growth among young children, in populations at risk for deficiency⁷.



Reduces the risk of preterm birth among pregnant women⁷.

4. Helen Keller International Cameroon, Ministère de la Santé Publique du Cameroun, UNICEF. National survey of micronutrient status and consumption of fortifiable foods. Yaoundé (Cameroon): Helen Keller International–Cameroon; 2011.

5. Guidelines on food fortification with micronutrients. WHO/FAO. Lindsay Allen, Bruno de Benoist, Omar Dary, Richard Hurrell. 341p. ISBN 92 4 159401 2.

6. Mayo-Wilson E, Junior JA, Imdad A, Dean S, Chan XHS, Chan ES, Jaswal A, Bhutta ZA. Zinc supplementation for preventing mortality, morbidity, and growth failure in children aged 6 months to 12 years of age. Cochrane Database Syst Rev. 2014 May 15;5:CD009384.

7. Ota E, Mori R, Middleton P, Tobe-Gai R, Mahomed K, Miyazaki C, Bhutta ZA. Zinc supplementation for improving pregnancy and infant outcome. Cochrane Database Syst Rev. 2015 Feb 2;2:CD000230.

KEY PROGRAM MILESTONES

Discussions on zinc deficiency in Cameroon occurred in the context of broader discussions about addressing hidden hunger and micronutrient deficiencies. The idea for a possible food fortification program came from HKI's experience implementing similar programs in West Africa. The key milestones that led to wheat flour fortification with zinc in Cameroon were the following:

2008 Advocacy for the creation of a national food fortification program in Cameroon

Following the creation of regional food fortification policies in West Africa during 2005-2008, advocacy in Cameroon focused on creation of a national food fortification program to contribute to the reduction of micronutrient deficiencies among women of reproductive age and children.

Donor funding secured for food fortification

Initial fortification planning activities were supported by a grant from the Michael and Susan Dell Foundation to HKI, and UNICEF contributed support for the baseline survey and standards elaboration process.

2009 National Food Fortification Alliance (NFFA) launched

In 2009, the National Food Fortification Alliance (NFFA) was launched, bringing together key stakeholders from government (ministries of public health (MOPH), industry, and trade); consumer associations; NGOs; UN organizations; the food standards agency; and food manufacturing industries, under the leadership of the MOPH.

Fortification strategic plan developed and adopted

A technical group of NFFA members led the development of the fortification strategic plan, which was adopted during the launching of the NFFA.

National Micronutrient Survey and industrial assessment

After creation of the NFFA, baseline information for the program was collected. This included the 2009 National Micronutrient Survey, which assessed dietary intake and the burden of micronutrient deficiencies among vulnerable groups,⁸ and an industrial assessment to confirm the presence of viable large-scale food industries with available channels for food marketing and distribution. Capacity-building needs in terms of industry staff skills and additional equipment to conduct fortification activities were also assessed.

2010 Food vehicle selection

Wheat flour was determined to be an appropriate food fortification vehicle for a mixture of micronutrients (zinc, iron, folic acid, and vitamin B12) present in inadequate amounts in the diet. Vegetable oil was selected as a vehicle for vitamin A.

Development of national wheat flour fortification standards

Based on dietary intake data and WHO recommendations for fortification levels⁹, fortificants were selected and fortification levels set at 95 mg zinc per kg of flour, which is recommended where average per capita wheat flour availability is < 75 g/day and the flour extraction rate is low⁹.

Capacity building of main stakeholders

Capacity building activities were undertaken: 1) among industries, with a focus on fortification processes as well as food safety and quality assurance/quality control; and 2) among food control bodies (reference laboratories, border control agencies, and food control bodies), regarding techniques for monitoring and control of fortified products.

Support to national industries

A MOU including the government, HKI and industry was signed to support industries with equipment and premix procurement.

2011 Adoption of fortification legislation

A joint ministerial order made fortification of all wheat flours (locally produced and imported) with zinc, iron, vitamin B12 and folic acid mandatory.

National monitoring and evaluation plan for food fortification

A monitoring and evaluation plan was developed for external control of food in industries, markets, and ports of entry along with program monitoring and impact surveys.

Food fortification communication strategy

A food fortification communication plan, which included TV documentaries, TV and radio spots, briefings with TV and radio journalists, billboards, and flyers, was developed and implemented, and stakeholders were kept abreast of the program through periodic NFFA meetings.

Official launch of wheat flour fortification in 2011

During the program implementation process, the industry expressed concerns about the additional costs related to fortification. Numerous exchanges and advocacy meetings were convened with the different partners to gain industry commitment. These discussions focused on the health and productivity benefits of the fortification program for the population and the corporate social responsibility of the industry. The fact that the government planned to support some of the initial investments (i.e. capacity building, fortification dosing equipment and premix procurement) and to make fortification mandatory nationwide contributed to industry acceptance of the program.

8. Helen Keller International Cameroon, Ministère de la Santé Publique du Cameroun, UNICEF. National survey of micronutrient status and consumption of fortifiable foods. Yaoundé (Cameroon): Helen Keller International–Cameroon; 2011.

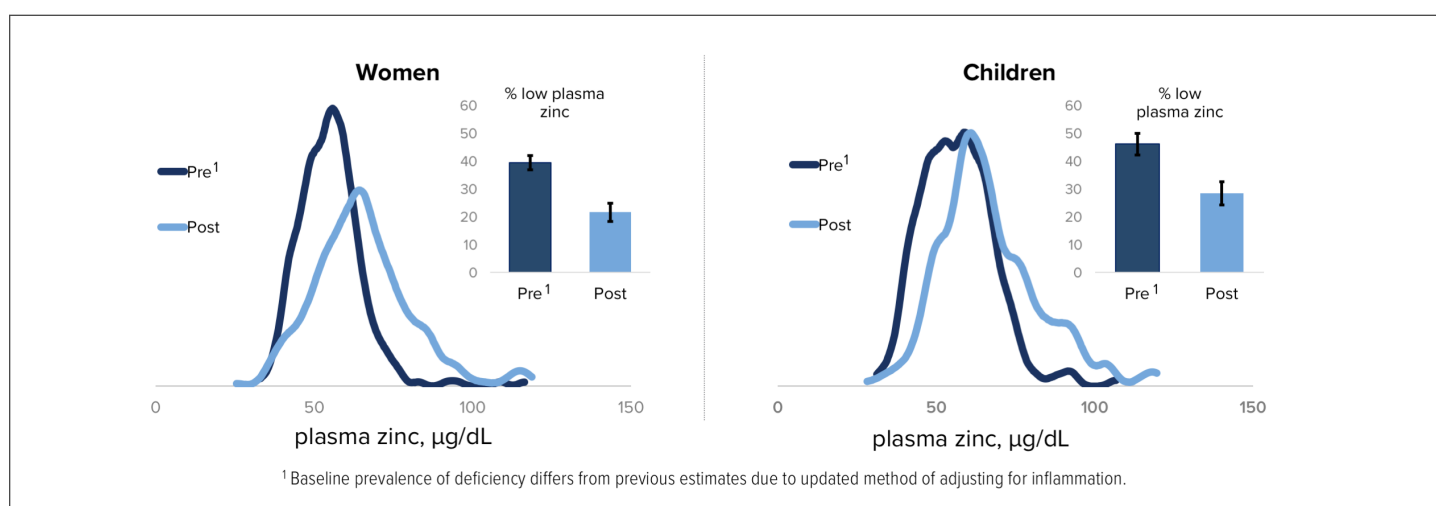
9. WHO. Recommendations on wheat and maize flour fortification. Meeting report; interim consensus statement. WHO/NMH/NHD/MNM/09.1. 2009.

IMPACT AND SUSTAINABILITY

In 2012, one year after initiating wheat flour fortification, an interim program impact evaluation was conducted in the two major urban areas of Cameroon, Yaoundé and Douala. Because resources were inadequate to conduct a national study and the fortification program was still new, these cities were selected due to the likely availability of fortified products and the relatively high consumption of wheat flour observed in the baseline survey. Results showed a significant increase in plasma zinc concentrations among both women and children after fortification (**Figure 2**). The prevalence of low plasma zinc concentrations (adjusted to account for the effect of inflammation) decreased from 46.8% to 28.4% among children and from 39.4% to 21.6% among women¹⁰. There was no evidence of consumer or producer complaints based on sensory issues.

A market survey and an industrial inspection were also conducted nationwide. The results indicated that all major millers were fortifying their products, and the average zinc content of wheat flour samples in markets was approximately 75% of the target level. Since there were no other known causes of major dietary shifts during this one-year period and because improvements in the status of the other three micronutrients added to wheat flour (iron, folic acid, and vitamin B12) were also observed, the results strongly suggest that the change in zinc status was attributable to the fortification program.

Figure 2. Distributions of plasma zinc concentration among women and children in Yaoundé and Douala, Cameroon, before and after introduction of zinc-fortified wheat flour.



Looking ahead

Since its inception, the program has been heavily partner-driven (rather than government-driven) which represents a threat to its sustainability. Following a decrease of partner support in 2013–2014, the program slowed down. NFFA meetings ceased and routine monitoring and control activities were irregular and unstructured due to a lack of state funding and the underlying weakness of the monitoring system. In 2016, with support from HKI, the government conducted a second round of monitoring and control activities which showed that, even though virtually all mills were fortifying wheat flour, the zinc levels in flour were less than 50% of the standard.

The NFFA was also revamped and a meeting was organized in December 2018 to share the latest results of the program's monitoring and evaluation activities. The need to update the national fortification monitoring and evaluation plan was highlighted with the aim of bolstering the sustainability of the program and ensuring its inclusion in routine government regulatory activities. Simulations using dietary intake data from the fortification baseline survey have suggested that fortification of wheat flour at the target level is likely to reduce, but not eliminate, inadequate zinc intake. To further reduce the prevalence of zinc deficiency, the NFFA with

the support of its technical partners, envisions the expansion of mandatory food fortification to other foods (e.g., bouillon cubes). Modeling tools such as those developed by the MINIMOD¹¹ project are being applied to examine the potential effectiveness and cost-effectiveness of alternative and complementary activities for improving zinc status in Cameroon. A new food fortification plan and a monitoring and evaluation plan are being developed based on a program impact pathway highlighting essential components for sustainable programs including national commitments.

10. Engle-Stone R, Nankap M, Ndjebayi AO, Allen LH, Shahab-Ferdows S, Hampel D, Killilea DW, Gimou MM, Houghton LA, Friedman A, Tarini A, Stamm RA, Brown KH. Iron, zinc, folate, and vitamin B-12 status increased among women and children in Yaoundé and Douala, Cameroon, 1 year after introducing fortified wheat flour. *J Nutr.* 2017; 147(7):1426-1436.

KEY LESSONS LEARNED

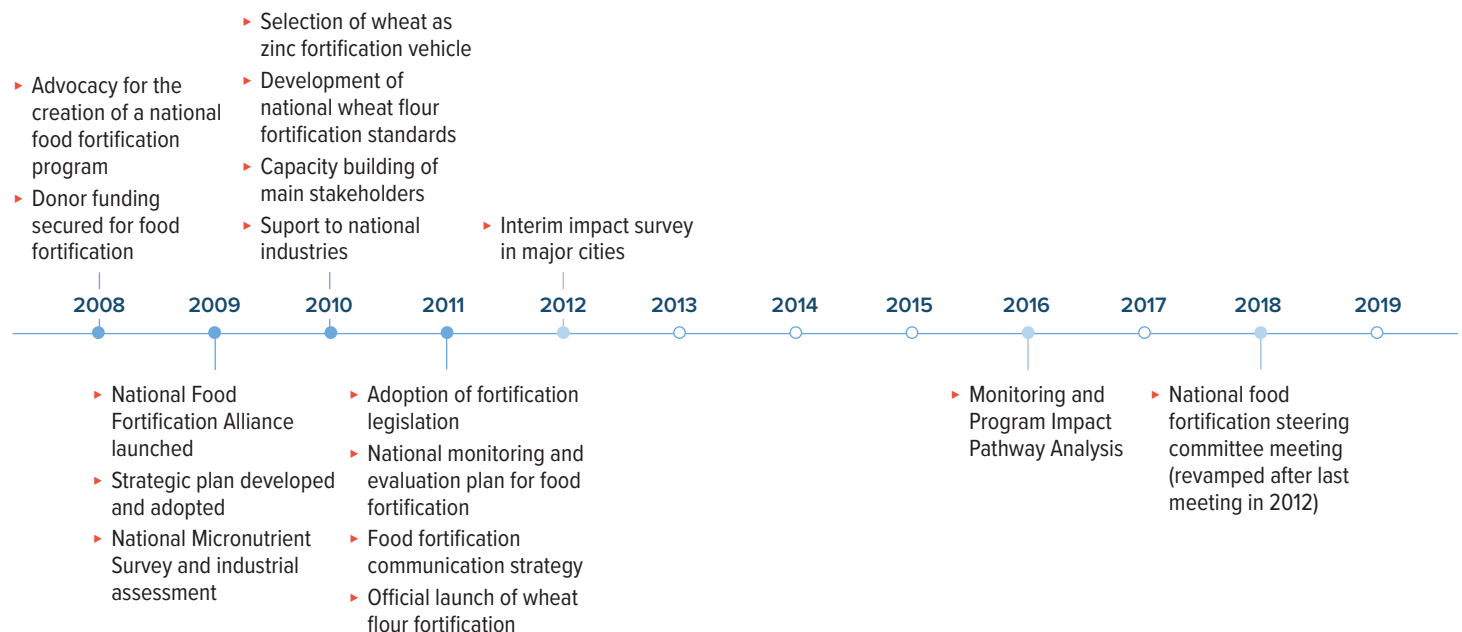
- ▼ **Importance of data:** Data on micronutrient status is required to accurately define the problem, dietary intake data is needed to identify the possible food vehicles and to model possible impact, costing data is essential for planning and budgeting, monitoring data is critical to assess industry compliance, and evaluation data is needed to demonstrate impact. Without data, it would not have been possible to identify or address the program's faltering. Partnering with researchers helps with data quality and innovation, and with documentation and dissemination.
- ▼ **Planning for micronutrient deficiency control:** Discussions should start by describing the problem to be solved rather than focusing initially on one intervention based on a single stakeholder's preference. Discussions about the best solutions to address micronutrient deficiencies should consider all possible interventions and their relative effectiveness and cost-effectiveness in the short- and long-term, to make sure that resources and efforts are invested in the most cost-effective and coordinated package of interventions. Multi-sectoral and multi-actor coordination, such as the SUN movement platform, and the application of modeling tools (such as MINIMOD¹¹), should facilitate this integrated approach.
- ▼ **Engagement:** All stakeholders should be engaged from the beginning to obtain diverse inputs and concerns early on, and to build a stronger program that will have adherence and support. It is better to work in collaboration with industry rather than simply imposing standards.
- ▼ **Impartial convener:** It is important to have an organization or a person to bring all stakeholders together. A convener that does not just represent the government regulatory agency or the private sector is key to maintaining trust and obtaining consensus on how to advance the program.
- ▼ **Perseverance:** Fortification brings together a wide array of stakeholders who move at different paces and have different interests, so there is a need for a long-term vision and to maintain advocacy and support activities until all program components are functional and complete national ownership is reached.
- ▼ **Commitment:** High-level, publicly-voiced commitment, legislation and existence of a fortification program plan are not enough to ensure the program's performance and sustainability. Commitment should also translate into national budget allocation for the program coordination and monitoring system.
- ▼ **Process for putting in place fortification programs:** Recognition that multiple vehicles (e.g. salt, wheat flour, and vegetable oil) and micronutrients need to be considered simultaneously, to increase program efficiency. Moreover, fortification programs need to be reassessed over time to ensure they remain relevant and meet current needs, based on evolving dietary patterns. In the case of Cameroon, zinc may need to be delivered through an additional delivery platform, which could be another fortified food, or other complementary strategies such as supplementation, production of zinc-rich crops, or programs to encourage optimal breastfeeding and complementary feeding practices. A well-defined Program Impact Pathway describing all essential components of the program helps define roles, responsibilities and resources needed for program activities and with development of the monitoring plan.



11. Vosti SA, Kagin J, Engle-Stone R, Brown KH. An economic optimization model for improving the efficiency of vitamin A interventions: An application to young children in Cameroon. *Food Nutr Bull.* 2015; 36 (3 Suppl): S193-207.

SUMMARY

Figure 3. Timeline for wheat flour fortification with zinc in Cameroon.



Key scientific evidence generated

Engle-Stone R, Ndjebayi A, Nankap M, Brown KH. Consumption of potentially fortifiable foods by women and young children varies by ecological zone and socio-economic status in Cameroon. *J Nutr.* 2012 Mar; 142(3):555-65.

Engle-Stone R, Nankap M, Ndjebayi AO, Killilea DW, Brown KH. Stunting prevalence, plasma zinc concentrations, and dietary zinc intakes in a nationally-representative sample suggest a high risk of zinc deficiency among women and young children in Cameroon. *J Nutr.* 2014 Mar; 144(3):382-91.

Engle-Stone R, Nankap M, Ndjebayi AO, Allen LH, Shahab-Ferdows S, Hampel D, Killilea DW, Gimou MM, Houghton LA, Friedman A, Tarini A, Stamm RA, Brown KH. Increase in biomarkers of iron, zinc, folate, and B-12 status observed among women and young children in urban Cameroon one year after introduction of fortified wheat flour. *J Nutr.* 2017; 147(7):1426-1436.

Mark H, Guintang Assiene J, Luo H, Nankap M, Ndjebayi AO, Teta I, Tarini A, Pattar A, Killilea DW, Brown KH, Engle-Stone R. Monitoring of the national oil and wheat flour fortification program in Cameroon: Application of a program impact pathway framework. *Curr Dev Nutr.* 2019 Jun 20;3(8):nzz076. Doi: 10.1093/cdn/nzz076.

OUR VISION

IZiNCG sees a world in which no child suffers from infectious disease, stunting, premature death, or other adverse conditions because of zinc deficiency.

OUR MISSION

IZiNCG aims to provide leadership by advocating and supporting well-designed and effective zinc nutrition interventions at scale for children and women, based on sound technical guidance and best practices. IZiNCG aims to pool together the talents and experience of the world's leaders in zinc nutrition and become a global resource for the best science, strategic thinking, and policy recommendations to control zinc deficiency.

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