Home Fortification with Micronutrient Powders:

Lessons learned from formative research across six countries

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Key messages

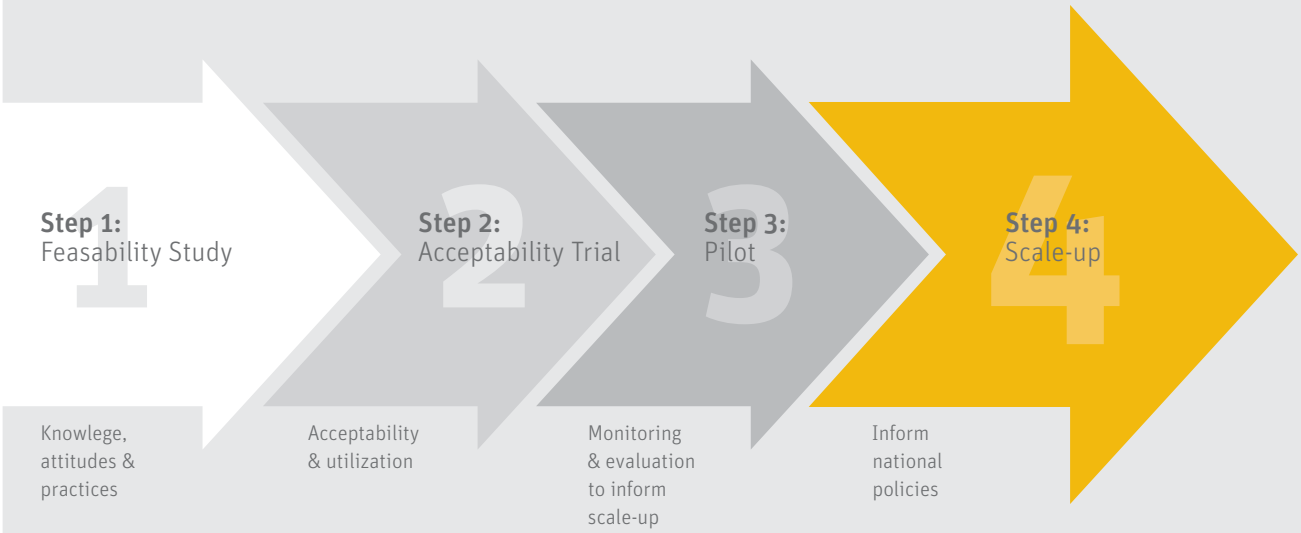
- Formative research prior to implementing home fortification with micronutrient powders (MNP) is imperative for guiding successful implementation and scale-up.
- Information is needed on country-specific Infant and Young Child Feeding (IYCF), particularly complementary feeding, food availability, common beliefs and practices.
- Messages and training materials that are not culturally appropriate and regionally specific may lead to low compliance and ineffectiveness.
- MNP are said to be "easy to use," but our findings suggest this may be compromised where food vehicles, or feeding practices, are not in accordance with global guidelines for usage.
- Acceptability, compliance, and willingness to continue using MNP are very high where caregivers are well informed and given simple, adaptable options in local circumstances.

The case for home fortification

Early life nutrition is central to the fight against undernutrition. Many countries have signed up to the Scaling Up Nutrition (SUN) movement and the 1,000 Days strategy that targets conception to age two. Micronutrient deficiencies, which often occur with other forms of undernutrition, are less visible, and are referred to as the 'hidden hunger'.[1] Micronutrient deficiencies associated with under-five mortality include vitamin A, zinc, iron, and iodine, collectively affecting over 1.2 million children annually.[2]

Those who survive undernutrition in early life often face irreversible consequences in cognitive and physical development.[3] Global organizations emphasize the importance of meeting nutritional needs in the first 1,000 days of life,[4] including

FIGURE 1: Steps to scaling-up MNP programs.



exclusive breastfeeding for 6 months followed by nutrient-dense complementary foods.[5] In many resource-limited settings, however, available foods contain insufficient amounts of micronutrients, particularly iron, zinc, calcium, vitamin B_{12}, and vitamin A, which are typically found in animal-source foods.[6,7] Thus, access to micronutrient interventions is crucial to meet the needs for early life. Young children aged 6–23 months should receive fortified foods or micronutrient supplements to ensure their adequate growth and development.[5]

> "Young children aged 6–23 months should receive fortified foods or micronutrient supplements"

Staple food fortification is an option, but rapidly growing young children lack the stomach capacity to consume enough of these foods to meet their requirements. More highly fortified infant foods address this issue but are often unaffordable. Micronutrient supplements, such as iron drops for young children, are also associated with side effects and compliance issues. Home fortification with micronutrient powders (MNP) is widely recommended,[8–10] where caregivers simply add the powdered vitamins and minerals to improve the food quality.

Home fortification with MNP: low-cost and effective

Many countries are interested in implementing home fortification with MNP due to its proven effectiveness and low cost. Global evidence-based guidelines have been developed,[9,10] although a gap exists between the guidelines for use and successful operational protocols. Although MNP are said to be "safe, effective, and easy to use," the effectiveness of home fortification with MNP depends on how it is used, and behavior change and community acceptance. Images, messages, and protocols must be well understood and followed for optimal use. In the past, the images on MNP packages, instructional pictograms, and even the shiny packages themselves, were not always well received – especially in populations with low literacy, where they were viewed with suspicion. For program success, the local context, cultural practices, and beliefs must be considered.

The Micronutrient Project at the University of British Columbia (UBC) has developed a methodology for the scaling-up of protocols for home fortification with MNP (**Figure 1**), for integration into national Infant and Young Child Feeding (IYCF) programs. In this article, we present an overview of our methods and lessons learned from six countries: Rwanda, Zambia, Uganda, Cameroon, Sierra Leone, and Lao PDR, where we conducted formative research and acceptability trials of MNP.

Methods

Step 1: Feasibility study

Objectives:

1. to understand knowledge, attitudes, and practices for IYCF by caregivers of children (6–23 months), healthcare workers, and community leaders;

TABLE 1: Acceptability Trial – Sample size per region by country.

	Duration (days)	# Mother-child[a] pairs
Rwanda		
Musanze district	30	30
Nyaruguru district	30	30
Zambia		
Chainda catchment area	30	33
Palabana catchment area	30	32
Cameroon		
Garoua health district	30	30
Ebolowa health district	30	30
Lao PDR		
Khongasaedon district	14	30
Lakhonpeng district	14	30
Sierra Leone		
Tonkilili district	25	40
Kono district	25	40
Uganda		
Amuria district	20	33
Kanunga district	20	31

[a]Mother with children ages 6 –23 months

2. to identify influential community members and communication channels; and
3. to establish a foundation for developing communication materials.

The feasibility study used a qualitative method and the Framework Approach[11] to analyze data, like other situational analyses, conducted before program implementation.[12–14]

Focus group discussions (FGD) and key informant interviews (KII) were conducted with caregivers of children aged 6–23 months (mothers, fathers, and grandmothers), healthcare workers, and community leaders. The sample size was based on previous research and country-specific needs to evaluate regional variation.

The data were imported and managed with NVivo qualitative data analysis software,[15] and hand-coding was used for small datasets. The data were examined with multiple iterative processes and analytic tools for word frequency and text searches, and visualization was used to describe dominant themes. Representative quotations were chosen to highlight the participants' ideas and to show the depth and breadth of the thematic content. Themes of interest were complementary foods (type, consistency, frequency); beliefs about healthy foods, food taboos and methods of feeding (e.g., hand, spoon, cup); and characteristics of a "healthy" child. Findings then guide messages for the trial, particularly for appropriate food vehicles and the reasons for providing the product to young children.

Step 2: Home-based acceptability trial

Objectives:

1. to determine the acceptability of MNP at the household and community levels;
2. to assess the use of MNP in relation to current guidelines and determine appropriate food vehicles;
3. to test the MNP package design and the information, education, and communication materials tested during **Step 1**.

Caregivers with children (6–23 months) receive a supply of MNP and are instructed to add no more than one sachet per day to their children's food over 14–30 days in two or more regions (n=30 mother/child pairs per region) (**Table 1**). UBC trains local healthcare workers on IYCF principles and use of MNP, often using cooking demonstrations with local foods. Caregivers then undergo a similar training led by the healthcare workers. After receiving training, the caregivers are administered a questionnaire at baseline, midline, and endline, and data are analyzed using SPSS software.[16] The questionnaires assess usage, includ-

TABLE 2: Feasibility Study – Sample size.

	Rwanda	Zambia	Cameroon	Lao PDR	Sierra Leone	Uganda
FGD[a] participants (n)						
Mothers	180	100	100	32	117	48
Fathers	0	0	100	24	116	46
Grandmothers	0	0	0	0	121	0
Total participants	180	100	200	56	354	94
FGD total (n)	18	10	20	8	60	16
KII[b]						
Mothers	26	10	10	8	20	48
Fathers	18	10	10	8	20	21
Grandmothers	18	10	10	8	20	24
Health care workers	43	30	44	10	22	18
Community leaders	0	0	24	14	22	23
KII Total	105	60	98	48	104	134
Total sample size	**285**	**240**	**298**	**104**	**458**	**228**

[a] Focus Group Discussions.

[b] Key Informant Interviews.

ing number of sachets consumed, food vehicles used, ease of use, perceived changes in the child and response to the food, acceptance and perceptions of MNP in the community, and caregivers' recall and understanding of the key messages and instructions.

Results

We present data from six countries on the feasibility study and acceptability trials.

Step 1: Feasibility

The sample sizes for the FGD and KII varied, according to the number of regions in each country (Table 2).

IYCF

The age of introduction of first foods ranged from 0–12 months, with 6 months being the most frequent response (Table 3). First foods were primarily grain-based, with consistencies ranging from dilute porridge to dense foods such as sticky rice (Lao PDR) and *nshima* (Zambia) (Table 3).

Ensuring the MNP sachet contents are consumed entirely depends on feeding practices as well as food vehicles. The recommendation is that MNP are to be mixed with a small amount of solid food and actively fed to the young child. Some important barriers for this practice can be hand-feeding, self-feeding, the consumption of dilute porridge, and in some places, such as Lao PDR, premastication of young children's food.

> "Children under one year are fed by hand. They are fed chewed sticky rice."
> *(Grandmother, Lao PDR)*

> "Child feeds on his own using his hands; if it's porridge, he uses a cup without a spoon."
> *(Mother, Uganda)*

In many regions, food was eaten from a common bowl. This is also a challenge for ensuring that only the young child consumes the entire contents of the MNP sachet.

Table 4 presents examples of knowledge and beliefs of complementary foods, definitions of healthy child, and foods thought to prevent anemia. Although most taboos or food beliefs were innocuous, in some regions, we found taboos that have a negative influence on child feeding.

> "There are taboo foods we do not give our young children, like meat and fish – so they do not practice stealing."
> *(Mother, Sierra Leone)*

> "Foods like greens should not be fed because they do not make the child grow, and sorghum bread because the child's stomach is not fully developed."
> *(Mother, Uganda)*

TABLE 3: Feasibility Study – Sample size.

	Rwanda	Zambia	Cameroon	Lao PDR	Sierra Leone	Uganda
First foods: age (range)	6 mo (2–8 mo)	6 mo (2–6 mo)	6 mo (0–6 mo)	6 mo (0 –12 mo)	6 mo (6 –11 mo)	6 mo (3–6 mo)
First foods: type and consistency	Porridge from sorghum, maize, or cassava; thin[a] watery Fruits, e.g., passion fruit, tree tomato	Porridge from maize; *nshima*[b] watery-medium Fruit & vegetables	**South:** *bouillie*[d] from maize, millet, sorghum, rice and/or soya, cassava; thin, watery **North:** *bouillie* from maize, millet, sorghum, rice; thin, watery	Sticky rice; dense Rice porridge; thin-medium	BENNiMiX[f] porridge, or pap; thin-medium	*Posho* (millet or maize porridge); greens pounded with groundnut or sesame paste; thin, watery *Atap* bread made from cassava and/or sorghum; dense
Additions to first foods	Sugar, milk	Groundnuts, gravy, oil, sugar, *kapenta*[c]	Peanut sauce, peanut butter	Pre-chewed meat, morning glory, meat, fish, other vegetables	Legumes, grains	Sugar, milk, groundnut paste, sesame paste
Feeding implement | vehicle *(e.g., self vs active; child eats from own own bowl vs. family pot/common bowl; flatware used vs. handfed).*	**Porridge:** drink, usually fed with a cup	Eat from own bowl until 23 mo	Fed in separate bowl between 4–10 mo	**Sticky rice:** Pre-masticated, hand, caregiver feeds by hand **Rice porridge:** spoon-fed by caregiver (if less than 1yr) or self-fed	Most eat from separate bowl until 1 yr	Fed by caregiver; older child self-feeds; 77% said child's food prepared separately; *posho* commonly consumed in cup
MNP food vehicle(s) options	Soft Irish potatoes, beans, greens (e.g., amaranth leaves), thick porridge	Thick enriched porridge; *nshima* with relish e.g., legumes, vegetables	Couscous with sauce; thick & enriched *bouillie*	Cooked, mashed pumpkin; cooked egg; ripe, mashed bananas	Thick 'pap'; rice with soup; soft mashed fruits	Thick *posho*; beans with sesame paste; soft mashed root vegetables

[a]Thin: (like soup/drink); Medium: not thick enough to stay on a spoon; Thick: thick enough to stay on a spoon

[b]*Nshima:* Maize flour porridge cooked slowly and thickened; more flour added than in porridge, pigeon peas, rice and sugar

[c]*Kapenta:* small fish

[d]*Boullie:* a watery porridge generally made from grains

[e]Brandname of unfortified, infant porridge produced in Bo, central Sierra Leone, made from sesame, pigeon peas, rice and sugar

Core perceptions of a healthy child were quite consistent with a good appetite and being active.

> "A healthy child is strong because he eats everything that he is given and does not refuse food. A healthy child runs and does activities; he is not tired."
> *(Grandmother, Lao PDR)*

In most countries, participants had heard of anemia, and many could identify the symptoms, but they incorrectly identified foods which could help prevent anemia (e.g., red fruits or green vegetables). Only in Lao PDR was a very iron-rich food identified (cooked, slightly congealed blood common in dishes such as soup or "duck larb").

> "The child becomes pale and the fingers and their eyes are pale."
> *(Mother, Rwanda)*

TABLE 4: Examples of caregivers' knowledge and beliefs.

	Rwanda	Zambia	Cameroon	Lao PDR	Sierra Leone	Uganda
Food taboos | beliefs	Avocados damage liver in young children; red colored fruit benefits blood	Boiling avocado leaves and drinking the water helps prevent anemia	**South:** *Bouillie* should not be very thick **North:** Colostrum is "bad" or "dirty" milk, a source of disease	Children should receive warm water and pre-chewed sticky rice from birth	Consumption of eggs, meat, and fish fish can lead to witchcraft and stealing	First foods should be 'thin'; cold food causes diarrhea and worms
Signs of a healthy child	Playful, good appetite, growth | weight gain	Weight gain, playful, active	Child has energy, likes to play, good appetite	Good appetite, active, happy and smiling, playful	Playful, active, good appetite; 'chubby'	Playful, eating well
Foods to prevent anemia	Fruit e.g., tree tomatoes & green vegetables	Coca-Cola, fruit e.g., avocado, papaya, bananas	Cassava leaves, foods or drinks red | dark in color, Coca-Cola	Blood of cow, buffalo, or duck	Potato leaves, eggs with palm oil	Cabbage and tomatoes "provide blood"; fruit e.g., papaya, oranges

MNP attitudes and communications

The practice of enriching staples or adding high-energy foods such as groundnuts or sesame was common in several countries. Participants reacted positively to the concept of adding vitamins and mineral powders to the food of young children.

We pretested the communication materials and sought potential communication and distribution channels. Table 5 shows the potential information sources and communication channels. Radio was the most common, though numerous alternative channels and opportunities were also presented, ranging from drama performances in Zambia to the unique Umuganda (community coming together) in Rwanda.

The caregivers in Lao PDR were most anxious about products sold at shops, as they were concerned about contaminated or counterfeit products, and thus requested that MNP be distributed through pharmacies or health centers only. Further, almost all caregivers made it clear that they wanted complete information regarding the content and formulation of the MNP.

> "I want to know all the vitamins in the sachet … and written detailed information. … I want advertisements about MNP in our community to let everyone here know …"
> *(Father, Lao PDR)*

Step 2: Home-based acceptability trial

The recommendations from the feasibility study were widely accepted (Table 6). The overall consistency of foods improved. Also, more caregivers fed their children from their own bowls using spoons.

The caregivers had positive perceptions about the changes in their children during the short trial, and most felt that their children had more appetite and activity (Table 7). In Cameroon, some children refused food with the added MNP, which

FIGURE 2: Rwanda – Final sachet design.

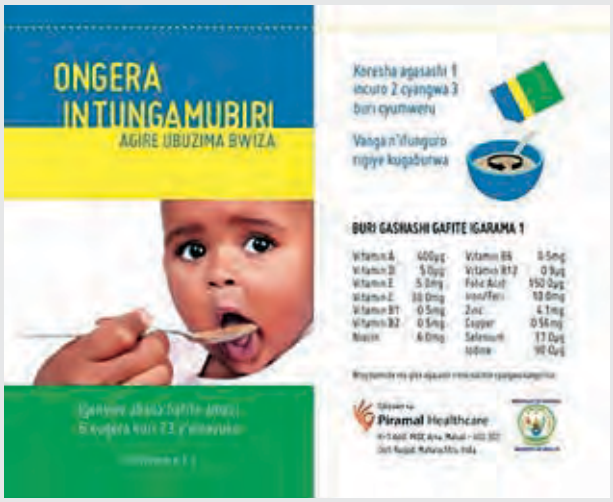


TABLE 5: MNP[a] communications.

	Rwanda	Zambia	Cameroon	Lao PDR	Sierra Leone	Uganda
Preferred health information communication channel	Radio; handouts or posters in health centers; newspaper	Radio; community gatherings; drumming or drama performance	Health center; hospital	Pharmacy; healthcare centers; hospitals	Radio; oral|audio|personal communication by health workers	Health workers; pictures; radio
Respected sources of health & MNP[a] information	Community health workers; local leaders	Health care workers; district chiefs; headmen	Community health workers; village head; health care workers	Village health volunteers; health care workers; village head	Health workers; community health officer	Village health team, health workers, & local council members
Opportunities for BCC[b]|IEC[c]	*Umuganda* (i.e., community gathering|service)	Community gatherings; outreach activities	Outreach activities; village meetings	EPI; community gatherings; outreach activities	Routine clinic events (e.g., monthly growth monitoring, child's 'six-month-contact'); during health outreach	EPI[d]|Child Health Days; local council meetings; church gatherings

[a]Micronutrient powders | [b]Behavior Change Communication | [c]Information, Education & Communication | [d]Expanded Programme on Immunization

TABLE 6: MNP[a] utilization at endline surveys.

	Rwanda	Zambia	Cameroon	Lao PDR	Sierra Leone	Uganda
Main food vehicle(s) used	Irish potatoes (75%); Beans Green (68%); leafy vegetables (64%)	Porridge (73%); enriched porridge (56%); *Nshima* with gravy or green leafy vegetables (65%)	**North:** Couscous with green sauce (53%); porridge enriched with peanuts and sugar (42%) **South:** peanut sauce with rice or cassava (69%); ragout (27%)	Rice porridge (70%); vegetables (50%); cooked egg (48.5%)	Porridge (81%); rice (64%)	Porridge (41%); beans (28%); pumpkin, *matooke*, or cooked vegetable (23%)
Consistency[b]	Medium 50%	Medium (66%)	Thick or stiff (70%)	Rice porridge: Medium (65%)	Thick (82%)	Thick (85%)
Primary meal	Midday|lunch	Midday|lunch	Morning|breakfast	Morning|breakfast	Morning|breakfast	Midday|lunch
Child fed in own bowl	91%	96%	94%	50%	90%	94%

[a]Micronutrient powders

[b]Thin: (e.g., like soup\|drink); Medium: not thick enough to stay on a spoon; Thick: thick enough to stay on a spoon

TABLE 7: Caregivers' perception of MNP use on selected outcomes.

	Rwanda	Zambia	Cameroon	Lao PDR	Sierra Leone	Uganda
Increase in appetite (%)	68	80	94	96	71	67
Increase in activity (%)	55	77	87	98	77	81
Happier (%)	0	0	0	45	73	71
Stool turned dark|black (%)	0	0	0	54	51	50
Diarrhea[a]	0	2	0	5	10	10
Changes in color or taste (%)	Color (30%)	Color (24%); taste (5%)	43	Color (75%); taste (50%)	29	72
Child refused food (%)	22	0	20	4	0	9
Child preferred food (%)	0	0	0	0	81	87

[a]Defined as three or more loose stools per day in the previous two weeks

suggests that the training protocol needs to be modified. Training materials should be a resource that helps ensure caregivers are confident in experimenting with adding MNP to different foods that are healthy and well accepted by their children. Training materials should also promote responsive, active feeding so that children are encouraged to eat all the food mixed with MNP.

The acceptance of MNP and the willingness to continue was almost universal (Table 8).

In each country, the initial images and color schemes of packages that were pretested were based on key informant interviews with stakeholders, including Ministry of Health officials. In some countries (e.g., Uganda, Zambia, and Cameroon), the first draft of MNP sachet designs were based on preferences of caregivers, using images taken during local photo shoots. In other countries, new images were developed in partnership with a local design team. For instance, in Lao PDR, Population Services International's (PSI) graphic design team developed original, country-specific images in collaboration with UBC and UNICEF, which were pretested in a concurrent, but separate, feasibility study that sampled target consumers. Following the pretesting of the initial designs, the final packaging and messages (color, design, and images) were developed specifically in response to community feedback. In Rwanda, the colors reflected patriotism (national flag) and the name was descriptive in the local language (Figure 2). For Lao PDR, where distribution was to be both private and public, the package and name was designed to be inspirational (Figure 3). In Uganda, the image was instructional (Figure 4); it showed a mother actively feeding her healthy child (over 6 months).

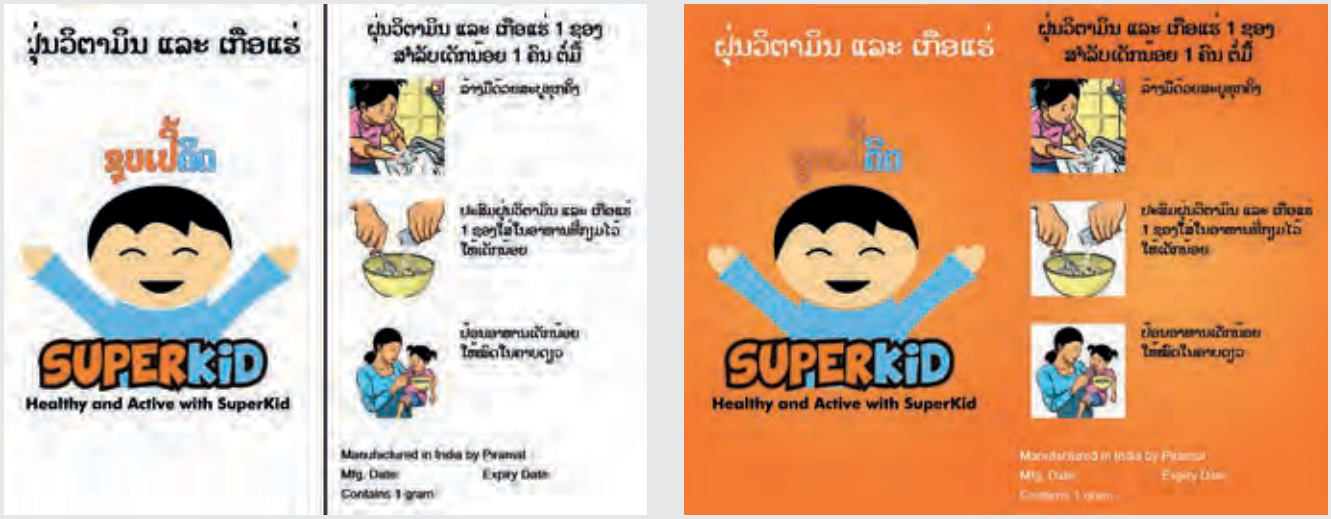
> "Home fortification with MNP is not a stand-alone intervention but is meant to be part of an improved IYCF protocol"

Discussion

Home fortification with MNP is not a stand-alone intervention but is meant to be part of an improved IYCF protocol. General guidelines indicate that MNP should be added to semi-solid food when the child is older than 6 months. We found a range in first foods and different consistencies. In Rwanda, the porridge was watery and provided as a drink. Since MNP does not dissolve well in water, the protocol was adjusted so that it would be added to soft cooked family foods, such as potatoes, bananas, and beans.

In Lao PDR, the opposite situation was found; first food was commonly sticky rice. Since MNP is not easily incorporated into a sticky rice ball, and color and taste changed, other food vehicles were identified, including cooked pumpkin, banana or egg. These options were included in the revised communication materials. In Lao PDR, earlier failure to identify a more appropriate vehicle resulted in low compliance.

FIGURE 3: Lao PDR – Final sachet designs (public and private distribution).



In the Western world, young children are usually actively fed first foods with a spoon, which is less common in many parts of the world where children are hand-fed when young, and self-feed by hand as they get older. However, this presents challenges, as the MNP often remains on the hand, especially if it has not been well combined with food.

These examples are typical of our experience in multiple countries and illustrate the need to test products to ensure they fit the local contexts. Caregivers could better make behavior changes that were simple modifications to existing practices.

Conclusion

Our findings confirm the need for formative research in guiding implementation of home fortification with MNP programs, since low compliance or inappropriate use will reduce their effectiveness. Giving MNP to a caregiver and simply telling him or her to add it to their child's food would probably be met with suspicion. Nevertheless, MNP trials with appropriate messaging, images, and culturally appropriate guidelines can succeed, and the formative research can be conducted in a relatively short time. Almost all of the caregivers in our research indicated they would continue using MNP, which speaks well for the training protocols.

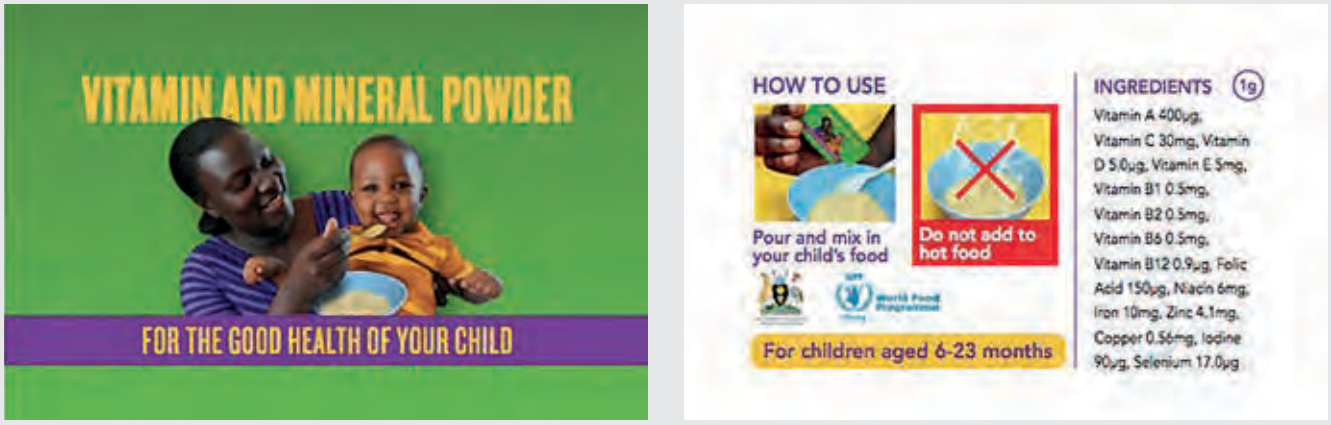
"Our findings confirm the need for formative research in guiding implementation of home fortification with MNP programs"

TABLE 8: MNP[a] acceptability.

	Rwanda (N = 60) %	Zambia (N = 65) %	Cameroon (N = 60) %	Lao PDR (N = 60) %	Sierra Leone (N = 80) %	Uganda (N = 64) %
Continue MNP if provided	100	100	99	100	100	100
Community & family members supportive	100	90	94	100	99	95
Heard rumors	0	10	12	17	1	14

[a]Micronutrient powders

FIGURE 4: Uganda – Final sachet design.



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