FOOD FORTIFICATION
FOR A SMARTER, HEALTHIER,
MORE PRODUCTIVE WORLD
HIDDEN HUNGER: A GLOBAL CHALLENGE

To live a healthy life, individuals need to consume a well-balanced diet that contains a mix of carbohydrates, proteins, fruits, vegetables, dairy, fats and oils. A diet rich in these elements provides 19 essential vitamins and minerals, known as micronutrients, needed to maintain health.

Yet today more than two billion people – that’s one in three people on the planet – suffer from micronutrient deficiency, otherwise known as hidden hunger.

Hidden hunger is a lack of the vital micronutrients needed to live a health life. Hidden hunger is different from hunger in that it is caused by the consumption of a diet that lacks essential micronutrients. Its impact can be devastating and long-lasting resulting in intellectual impairment, poor health and even death for those affected.

Hidden hunger represents one of the most common health problems worldwide, with vitamin and mineral deficiencies alone accounting for about 10% of the global health burden. It is a global health challenge affecting both developed and developing countries.

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1 Figure from the Micronutrient Initiative Accessed 1 May 2015 from http://www.micronutrient.org/english/View.asp?f=573
### 19 Essential Micronutrients and Their Function

<table>
<thead>
<tr>
<th>Micronutrient</th>
<th>Function</th>
<th>Sources in food</th>
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</thead>
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<tr>
<td><strong>Iron</strong></td>
<td>Immune function, major role in regulating energy production and delivering oxygen to the tissues</td>
<td></td>
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<tr>
<td><strong>Zinc</strong></td>
<td>Involved in the synthesis of DNA</td>
<td></td>
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<tr>
<td><strong>Iodine</strong></td>
<td>Required for the formation of thyroid hormone</td>
<td></td>
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<tr>
<td><strong>Vitamin A</strong></td>
<td>Required for vision</td>
<td></td>
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<tr>
<td><strong>Vitamin C</strong></td>
<td>An antioxidant, supports synthesis of collagen</td>
<td></td>
</tr>
<tr>
<td><strong>Vitamin D</strong></td>
<td>Bone health</td>
<td></td>
</tr>
<tr>
<td><strong>Folic Acid</strong></td>
<td>Required to prevent neural tube defects in infants</td>
<td></td>
</tr>
<tr>
<td><strong>Vitamin B1–Thiamin</strong></td>
<td>Role in nerve cells, required to maintain carbohydrate metabolism</td>
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<tr>
<td><strong>Riboflavin</strong></td>
<td>Central as a co-factor for energy yielding metabolism</td>
<td></td>
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<tr>
<td><strong>Niacin</strong></td>
<td>Part of the energy yielding metabolism</td>
<td></td>
</tr>
<tr>
<td><strong>Pantothenic Acid</strong></td>
<td>Central for energy yielding metabolism</td>
<td></td>
</tr>
<tr>
<td><strong>Vitamin B6</strong></td>
<td>Part of the energy yielding metabolism and has a role in the modulation of steroid hormones</td>
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<td><strong>Vitamin B12</strong></td>
<td>Key role in brain and nervous system functioning</td>
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<td><strong>Vitamin E</strong></td>
<td>Antioxidant</td>
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</tr>
<tr>
<td><strong>Calcium</strong></td>
<td>Bone mineralisation, blood clotting</td>
<td></td>
</tr>
<tr>
<td><strong>Phosphorous</strong></td>
<td>Bone mineralisation, blood clotting</td>
<td></td>
</tr>
<tr>
<td><strong>Biotin</strong></td>
<td>Important in the synthesis of fats and energy yielding metabolism</td>
<td></td>
</tr>
<tr>
<td><strong>Vitamin K</strong></td>
<td>Needed for blood clotting</td>
<td></td>
</tr>
<tr>
<td><strong>Selenium</strong></td>
<td>Antioxidant</td>
<td></td>
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</tbody>
</table>
HIDDEN HUNGER: A DISASTROUS IMPACT

Individuals

While hidden hunger rarely shows visible signs in those who are affected, its consequences can be disastrous for individuals. Hidden hunger leads to poor physical and mental health, increases child and maternal mortality and reduced cognitive development. Some of its most serious and visible manifestations include:

- **Spina bifida**, caused by a lack of folate that gives rise to neural tube defects (NTDs), resulting in often severe nervous system and brain damage
- **Goitre**, an abnormal neck swelling caused by the enlargement of the thyroid gland resulting from a lack of iodine

• Night blindness, which affects millions of adults and children and is caused by a lack of Vitamin A
• Increased incidences of pneumonia and malaria due to reduced resistance to infection, which can result from recurrent childhood diarrhoea caused by zinc deficiency
• Greater risk of death for anaemic mothers around the time of birth (the perinatal period) caused by Iron deficiency
• Impaired physical and cognitive development and increased risk of death in children caused by Iron deficiency
• Reduced work productivity in adults caused by iron deficiency

IRON DEFICIENT ANAEMIA

Iron Deficient Anaemia (IDA) is the only nutrient deficiency which is also significantly prevalent in high-income countries. Those most seriously affected by IDA are young children and women in low and middle income countries. IDA can cause extreme fatigue and depression. IDA impacts cognitive development and productivity, however timely treatment can restore personal health and raise national productivity levels by as much as 20%. IDA is associated with heart problems and may lead to rapid or irregular heartbeat, an enlarged heart and ultimately heart failure. IDA can lead to maternal haemorrhage and is associated with 20% of all maternal death. In many low and middle income countries, IDA is aggravated by worm infections, malaria and other infectious diseases such as HIV and tuberculosis.

Sources:
- http://www.who.int/nutrition/topics/ida/en/
- http://www.ajtmh.org/content/77/1/44.long
- http://www.mayoclinic.org/diseases-conditions/iron-deficiency-anemia/basics/complications/con-20019327

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Society
The consequences of hidden hunger are not exclusively limited to individuals. Hidden hunger impacts whole societies, effectively trapping many in a vicious cycle of poverty.

When a whole population is suffering from hidden hunger its educational attainment and economic activity drops. Children and young people are forced to repeat school years or end up with lesser qualifications, and adults are less productive, earning less for their families and thus exacerbating household poverty and denting GDP.

Women and Children
Of all the groups affected by hidden hunger, it is women and children from low and middle income groups within developing countries who shoulder the greatest burden. It is estimated that:

- Severe anaemia kills more than 50,000 women a year during childbirth.
- Iron deficiency alone undermines the health and energy of 40% of women in the developing world.
- 2 million children may die unnecessarily each year because they lack Vitamin A, zinc or other nutrients.
- 18 million babies are born mentally impaired due to iodine deficiency each year.

Women and Adolescent Girls
Ensuring optimal nutrition before and in the first 1,000 days between a woman’s pregnancy and her child’s second birthday has a lifelong beneficial impact on health (Black et al. 2013), and is also critical to ensure the child develops to their full physical and intellectual potential (Black et al. 2008).

In 2013, The Lancet highlighted the need for more nutritional interventions aimed at young adolescent girls (Black et al. 2013). Increasing evidence shows that adolescent girls need to be prepared for pregnancy and breastfeeding with adequate nutrient stores even before conception in order to ensure her children have the best start to life.

“Improving the nutritional status of adolescent girls benefits them as well as their future children. Food fortification can therefore play a critical role, providing micronutrients to adolescent girls.”

Martin Bloem, Senior Nutrition Advisor, World Food Programme (WFP)
There are many interventions that tackle hidden hunger, reduce and eliminate micronutrient deficiencies and improve nutrition, including vitamin and mineral supplementation, the promotion of dietary diversification and home food production. These can each be complemented by public health measures such as improved sanitation and hygiene, immunization and malaria and parasite control.

Yet food fortification – adding a small amount of micronutrients to a staple food or condiment – has been shown to be one of the safest and most cost-effective measures to tackle hidden hunger on a large scale.

With large scale food fortification (LSFF), regularly consumed staple foods are used to improve the micronutrient intake of adults and children. Micronutrients such as iodine, iron, zinc, calcium, Vitamin A, B-group vitamins and Vitamin D are commonly added in combinations that do not alter the appearance, taste, texture or smell of the food. This means that fortified food will not affect recipes or methods of cooking. And because many of the most vulnerable people in the world eat staple foods, food fortification has the ability to reach communities and individuals that other interventions cannot.

Food fortification is designed to build up micronutrient stores in people over time and without risk, so it is a safe and efficient way of improving nutrition without making people change their eating habits.

**ZINC DEFICIENCY**

Diarrhoea can be caused by zinc deficiency and zinc can act as a cure.

People who become zinc deficient have a lowered immune system and are more susceptible to pneumonia, malaria, and measles.

Zinc deficient children can suffer from cognitive dysfunction which can affect learning ability. This has an impact on earning potential.

Children who are zinc deficient can also suffer from physical impairment, skin conditions and stunted growth.

It is estimated 450,000 children die per year and 800,000 people in total die yearly in part due to zinc deficiency.

An established intervention

Food fortification is not a new concept. Since the early 1920s, countries such as the Netherlands, Switzerland and the United States of America have fortified staple foods with vitamins and minerals, resulting in the reduction and in some cases the elimination of a variety of micronutrient deficiencies including pellagra, rickets, beri beri and goitre.

The process of fortifying food is proven and requires only relatively simple technology. Taking a common staple such as flour as an example:

1. Firstly, a premix of the micronutrients is created, with the amount of vitamins and minerals to be added usually set at a proportion of the individual’s recommended daily allowance (RDA).
2. Next, at the flour mill the premix is added to the flour through a feeder and is mixed into the flour to ensure that the concentration of micronutrients is evenly distributed. In this way the amount of premix in the flour can be controlled.
3. Routine production line testing takes place to ensure the product complies with country specific fortification standards.
4. The final fortified product is packaged and then sent to market for consumer consumption.

“Food fortification is a proven and preferred strategy in the prevention and management of micronutrient deficiencies. It is effective, cost effective, has the potential to achieve high coverage and has been tested in many rigorous research studies.”

Regional East African Community Health (REACH) Policy Initiative May 2011

Fortification is always strictly monitored and, by implementing stringent quality control measures, producers can ensure that there is no excessive intake of a specific vitamin or mineral. Modern food processing and packaging technologies have now made food fortification a realistic option for improving the nutritional status of people in developing countries.
Proven impact

There is plenty of evidence that demonstrates the positive impact of fortified food on the nutrient status of individuals and communities.

For example, Indonesia’s rice and vegetable-based diet provides little naturally available Vitamin A, resulting in mild and moderate Vitamin A deficiency among pregnant and breastfeeding women and children of pre-school age. Combined with poverty and food insecurity, the diet is of poor quality and limited variety, resulting in high instances of micronutrient deficiency.

Oil fortification has been used to improve the Vitamin A status of adults and children in twenty-four villages in West Java. The results have been impressive. Fortified vegetable oil has improved Vitamin A intake, contributing between 26% – 40% of the daily recommended nutrient intake among the sampled members of the population. As a result of the fortified vegetable oil, cases of Vitamin A deficiency dropped substantially across all groups from a high of up to 18% to 6% or less.

When Uzbekistan launched a flour fortification program in 2005, the cost was 120 Sums (approx. US$0.10) per person, per year.

It has been calculated that the total cost of adding mandatory nutrients to flour in the United States is $0.07 per person per year.

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4 From the abstract in Public Health Nutrition, December 2014. Vitamin A-fortified cooking oil reduces vitamin A deficiency in infants, young children and women: results from a programme evaluation in Indonesia

5 http://www.who.int/evidence/resources/country_reports/RRSfoodfortification.pdf

Cost effective

Good nutrition is the foundation for good health and investing in nutrition is key to development efforts related to food, poverty, health, gender and employment. For every US$ 1 spent on nutrition at least US$16 will be returned in economic benefits, according to the 2014 Global Nutrition Report. In Uganda, micronutrient deficiency contributes to an estimated US$310 million in lost productivity which represents a 4.1% reduction in GDP (REACH Policy Initiative 2011).5

In 2010, the World Bank estimated that US$10.3 billion per year was required to scale up nutrition everywhere. Yet investing in nutrition provides a high return on investment. The World Bank has estimated that fortifying staple foods with iron and salt with iodine will bring a return of US$7.2 billion per year.

Not only does fortification help to prevent debilitating health conditions, it is also substantially cheaper than treatment. For example in Jordan the cost of fortification is 0.03 dinars (approx. US$0.04) per capita per year, whereas the cost of treating anaemia is 4.9 dinars (approx. US$7.00) per capita per year.
The impact of Universal Salt Iodization (USI)

In the Micronutrient Report 2001 – a worldwide review of progress in the control of micronutrient deficiencies – substantial declines in the prevalence of iodine deficiency were observed in countries that had achieved improved coverage of household iodized salt use over the same time period. In addition, Bolivia, Peru, and Cameroon all demonstrated a rapid improvement in the reduction of goitre prevalence of between 2.0% and 5.5% per year of the program.

Work in Bangladesh, Cambodia, China, India, Indonesia, Laos, Myanmar, Philippines, South Africa, Sri Lanka, Thailand, and Vietnam has shown a consistent relationship between improvements in the number of households with access to iodized salt and reduced prevalence of iodine-deficiency disorder symptoms (goitre) and the rates of cretinism. Whilst all countries showed an improvement, Vietnam, China and Myanmar have shown the greatest impact, with a 2.5% or more decrease in goitre per year.

GAIN’s role in Universal Salt Iodization

GAIN’s work on universal salt iodization (USI) in 14 countries has seen an increase in coverage from a baseline of 72.6% in 2009 to 80.3% in 2014. This means that approximately 195 million more people received adequately iodized salt to ensure their optimal iodine nutrition.
IMPACTFUL INTERVENTION: SALT IODIZATION

Fortifying salt with iodine is safe, relatively easy, has high returns on investment and is extremely inexpensive – an estimated $0.02–$0.18 per person per year.

Benefits include improved health, lowered health care costs, economic growth, and reduction of poverty.

One study found a decrease of 1% in malnutrition rate achieves a 4% reduction in poverty.

Much progress has already been made. The number of iodine deficient countries has more than halved in the past decade. Yet about 30% of households in the developing world are still iodine deficient. There are solutions to ensure full and sustained coverage and an opportunity to virtually eliminate iodine deficiency.

SPOTLIGHT ON CHINA: IODINE NUTRITION FOR ALL

In the early 1990s, over 700 million people in China were iodine deficient. Adults and children were affected by goitre and cretinism, which limited their learning potential, lowering IQ in children by more than 10 points, and impacted the nation’s economic development. But in 1993, China adopted salt iodization as its principal control strategy. This program of mandatory food fortification made enormous progress and by 2000 Universal Salt Iodization (USI) had virtually eliminated iodine deficiency disorders.
Large scale food fortification is a proven tool in preventing hidden hunger. It is one of the most effective and least costly measures we have to address this global challenge. Yet food fortification is not universally used and its benefits are not universally accessible.

Currently coverage of staple foods fortified with essential nutrients is inconsistent. While 150 countries are implementing salt iodization programs, there are at least 26 countries with an iodine status described as ‘inadequate’ (Global Nutrition Scorecard, Iodine Global Network 2014) where scaling up fortification could bring substantial health benefit to over 675 million people.

Similarly 81 countries have introduced regulation requiring the mandatory fortification of wheat flour or maize meal with micronutrients, and dozens of countries are developing guidelines for the fortification of edible oils, but in many countries, the uptake by manufacturers and consumers is slow.

Many more countries worldwide could eliminate deficiencies of key nutrients and bring significant health benefits to their populations by enforcing existing laws on mandatory fortification. Additionally, while private sector companies in many countries have initiated local fortification efforts, greater sharing of expertise and technology is required if local and domestic industries are to build their capacity to fortify staple foods with essential nutrients.

By expanding large scale food fortification we have an opportunity to eradicate many conditions linked to hidden hunger.

#FutureFortified, the Global Summit on Food Fortification, taking place 9 – 11 September 2015 in Arusha, Tanzania, is our opportunity to secure the political will and required funds to scale up food fortification efforts and put an end to hidden hunger.

“When I was younger, I saw a lot of people with goitre. I remember skinny children with swollen heads and necks who couldn’t speak properly. The affected children needed extra care and their families were ignored in the community.

We didn’t make the connection with iodine deficiency.

But now, there’s been a tremendous change of behaviour in recent years, with people preferring to use iodized salt now. You don’t see people with goitre round here anymore.”

Mulu, Ethiopia
The Global Alliance for Improved Nutrition (GAIN) believes that large scale food fortification is a critical tool in improving the nutrition of over 2 billion people suffering from micronutrient deficiencies – hidden hunger.

To date, GAIN’s support for large scale food fortification programs have contributed to:

- Reductions in neural tube defects in South Africa via wheat and maize flour fortification.
- Reductions in iron deficiency anaemia in Nigeria, Jordan and Morocco via wheat and maize flour fortification.
- Reductions in iron deficiency in China via fortification of soy sauce.
- Reductions in Vitamin A deficiency in Indonesia via the fortification of edible oils.
- In Rajasthan, India GAIN’s fortification project of atta wheat flour has resulted in 89% of the suitable atta flour being fortified, reaching 4.3million people.

GAIN undertakes advocacy with multiple stakeholders to highlight the importance of food fortification as a means of addressing micronutrient deficiencies for whole populations. GAIN’s targeted advocacy efforts in 16 countries have resulted in the passage of mandatory legislation in support of fortification.

So far:

- Mandatory legislation has been achieved in 12 countries, namely Bangladesh, Cote d’Ivoire, Egypt, Ghana, Indonesia, Kazakhstan, Kenya, Morocco, Pakistan (Punjab only), Tanzania, Uganda and Ethiopia, ensuring that over 870 million people will now have access to fortified food.
- Uganda, Tanzania and Ghana have reduce import/export duties on premix and fortified goods in order to create an environment that enables food fortification, and GAIN continues to undertake advocacy with many more.