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Food and Beverage Fortification in Africa?

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Abstract

An estimated 200 million people on the African continent, both children and adults, are under nourished and these numbers have been increasing. In the poorer regions of Sub-Saharan Africa, micronutrient malnutrition exists wherever there is undernourishment due to food shortages, and it is likely to become common where diets lack diversity. Household food security, quality of care, resources for health, including access to health services and a healthy environment are determinants of nutritional outcomes for both individuals and populations as a whole. Micronutrient deficiencies tend to exist mainly where diets lack diversity and intake of animal products is minimal. Therefore, poor sectors of the world, of developing or even developed countries, may have poor diets, even in conjunction with sufficient energy intake. One of the consequences of industrialization is reduced intake of many micronutrients, because of the large dependence of the food industry on salt, sugar, vegetable fats and refined cereals, all of which are poor sources of vitamins and minerals. Individuals whose diets depend heavily on these products often do not meet the daily requirement of many micronutrients. Micronutrient malnutrition is a widespread problem and it has both health and economic consequences. In poor countries, this deficiency is exacerbated by systemic infections and parasitic diseases that reduce nutrient absorption and biological utilization. The focus was changed from protein sufficiency to energy sufficiency and now to micronutrient sufficiency. Food fortification is common practice where malnutrition occurs and it can be a useful tool in combatting micronutrient deficiencies. However, more than 100000 phytonutrients exist and still unknown which may be essential micronutrients. African countries often face the challenge of determining which levels of nutrients are both efficacious and safe for the population at large. It is not an appropriate tool in all situations, and generally speaking, fortification requires combination with other techniques in order to obtain the optimal result, therefore its use is debatable in Africa. Eating a wide range of foods is the best way to ensure each person consumes enough of any micronutrient. Since diet diversity is not stimulated and explained in Africa, the question is if fortification is a business, an effective science demand or both in poor countries.

Keywords: *Diet Fortification; Food And Beverage Fortificants; Malnutrition; Africa*

Introduction

Sub-Saharan Africa is the poorest region in the world and there is a need of pursuing a deep transformation of the agricultural sector in Sub-Saharan Africa if incomes are to be risen and food security problems are to be mitigated. Agriculture can be an engine of growth early in the development process and also an important force for poverty reduction. The failure of growth over the long term has resulted in high levels of poverty in the region and developing countries have been producing few rich people instead of sustainable wealth for all. In the last five years the number of hungry people in Africa increased by 20 million, the total number grew from 175 million in 2008 to 239 million in 2013 [1]. In Sub-Saharan Africa, the modest progress achieved in recent years up to 2007 was reversed, with hunger rising 2% per year since then [2].

While in India food fortification and malnutrition, tackled since 1950, has been bridging the gap between evidence and action [3]. In Africa's malnutrition burden, especially in Sub-Saharan Africa, the subject is a recent development. There is a need for proper collection and application of data, since dietary patterns of an African community are often closely related to its ecological area, and each region has its own specificities and food habits. Sustained healthy and active life is only possible when the underlying determinants, namely food, health and care, are maximized. None of these is sufficient by itself, all are necessary for a good child development. Broad-based economic growth is necessary to increase incomes and consumption, thereby reducing poverty. However, it is also true that even in several countries that show good economic development, poverty and hunger continue to persist.

The potential intellectual, physical and technical capacity of the population is considered dependent on improved nutrition, particularly for young children and women in their childbearing years. Resources will determine the degree to which the three underlying determinants (food, health, and care) are expressed positively or negatively. These resources include the availability of food, but extend much further to include the physical and economic access that a child or his/her caregiver has to that food, the caregiver's knowledge of how to use the available food and to properly care for the child, the caregiver's own health status, and the control the caregiver has over resources within the household that might be used to nourish the child. Furthermore, the level of access to information and services for maintaining health, whether preventive and curative health services are available, and the presence or absence of a healthy environment with clean water, adequate sanitation, and proper shelter all contribute equally to determining the nutritional status of a child [4].

Deficiencies of micronutrients are a major global health problem [5]. More than 2 billion people in the world today are estimated to be deficient in key vitamins and minerals, particularly vitamin A, iodine, iron and zinc. Most of these people live in low income countries and are typically deficient in more than one micronutrient. Deficiencies occur when people do not have access to micronutrient-rich foods such as fruit, vegetables, animal products and fortified foods, usually because they are too expensive to buy or are locally unavailable. Micronutrient deficiencies increase the general risk of infectious illness and of dying from diarrhoea, measles, malaria and pneumonia. These conditions are among the 10 leading causes of disease in the world today [6].

Foods rich in vitamin A include beef liver, fish, eggs, poultry and dairy products, as well as cereals. Beta-carotene is provided by many fruits and vegetables, with sweet potatoes, spinach, carrots, cantaloupe and mangoes being especially rich. Eating a wide range of foods is the best way to ensure one consumes enough vitamin A or any other micronutrient. Because the body can store the vitamin, taking too much vitamin A has some health risks and may lead to symptoms that include neurological problems and joint pain.

The question remains if programs or donations frequently made by well-known international non-governmental organizations (NGOs) towards supposedly tackling the malnutrition burden in Sub-Saharan countries, will at all contribute to reduce malnutrition or have any direct impact on child malnutrition. For example, it is well recognized the lack of good link and information among the United Nations different organizations in the field.

The rationale for fortification

The WHO/FAO definition of food fortification is: "*the practice of deliberately increasing the content of an essential micronutrient ... so as to improve the nutritional quality of the food supply and to provide a public health benefit with minimal risk to health*". By definition, food fortification does more good than harm. One popular dietary myth is that the consumption of simple, minimally processed foods automatically translates into a healthy diet. As a consequence, any 'tampering with the food supply' by faceless scientific types is treated with suspicion and resisted. The defence of naturalism may be logical to a naive audience but it ignores the history of nutrient deficiency in humans. There is a need to take a holistic approach to food fortification, and hence emphasised many supporting activities which would facilitate efficacious fortification.

In 2012 the Nutrition Society of Australia conference a debate was held on the topic "Fortified foods do more harm than good" [7]. One of the recent arguments against food fortification is that it may be applied to junk foods and beverages, effectively making unhealthy foods look better than they are. Another criticism of fortification is that it undermines nutrition education. This view states that all peo-

ple should be educated about nutrition; fortification blurs the boundaries of what's healthy and what's not-so-healthy; and everyone finds it too confusing. Anti-food fortification arguments are a bit like arguments against vaccination. The success of both public health strategies is so profound and so well established that the wellbeing they create is assumed to be the norm.

Considerations beyond the methodologies employed in the addition of micronutrients to foods influence to a large extent the potential of food fortification to meet its nutritional objectives. These include: current technologies for determining micronutrient status of target population groups; bioavailability of certain micronutrients in fortified foods, and; impact of traditional practices on the stability of nutrients in fortified foods.

There have been a number of important lessons learned in the technical research and development work carried out for food fortification processes. These include:

- The long time and high cost required for the development of new combinations of fortificants and vehicles must be considered in planning fortification activity.
- Fortificants must meet quality criteria specifications explicitly established for each application, including; chemical stability, appearance, bioavailability and homogeneity.
- Field testing of fortified food must be done at several locations in the country of intended fortification use, due to differing environmental conditions, and consideration should be given to problems potentiated by scaling up production activities from pilot to industrial scale.
- In certain situations promotion of production and consumption of fortified foods proved to be a critical factor influencing the acceptability of the food.
- Active participation must be maintained by all partners involved in fortification programmes. These should include; relevant governmental organizations, food industry, trade organizations, consumer organizations, academic and research facilities, marketing specialists and interested international organizations and agencies.

The role of Nutrients and Micronutrients

Whereas wealthier population groups are able to augment dietary staples with micronutrient-rich foods (such as meat, fish, poultry, eggs, milk and dairy products) and have greater access to a variety of fruits and vegetables, poorer people tend to consume only small amounts of such foods, relying instead on more monotonous diets based on cereals, roots and tubers. The micronutrient content of cereals (especially after milling), roots and tubers is low, so these foods typically provide only a small proportion of the daily requirements for most vitamins and minerals. Therefore in the poorer regions of Sub-Saharan Africa, micronutrient malnutrition is certain to exist wherever there is undernourishment due to food shortages, and it is likely to become common where diets lack diversity. Most poor people eat a monotonous diet.

Nutrient requirements are complex issues and over 50 nutrients have been well identified. However, not all of them have been studied in depth. Only in cow's milk more than 600 fatty acids have been identified. Studies are rarely conducted in Sub-Saharan Africa and the nutritional content of traditional foods is not well identified. Besides, more than 100,000 (and researches speculate that likely there are many more) phytochemicals (polyphenols, terpenes, sulphur compounds and saponins), nutraceuticals (beta catenin, lutein, lycopene) and phytoestrogens are present in traditional unrefined foods [8].

The main data sources for nutritional indicators in Sub-Saharan Africa are usually based on Demographic and Health Surveys carried out by national statistical offices. The World Health Organization (WHO) has compiled child malnutrition data from these and other surveys into a global database on child growth and malnutrition [9]. Up the 1980s, efforts to alleviate undernutrition in developing countries were focused on protein-energy malnutrition. The burden of disease attributed to micronutrient deficiencies was often referred to as 'hidden hunger' [10].

Although it is well known that nutrient deficiencies normally are not single but multi-nutrient, it is common to read in the literature

that there are four principal micronutrient deficiencies of public health concern in Africa-vitamin A, iron, zinc, and iodine. Is this really true and is it just mainly for these nutrients? Where were they evaluated and by which laboratories? What are the nutrient interactions and the hidden commercial interests behind these statements? Is it correct just to claim that FAO or WHO supports this? One knows that in several other fronts these highly reputable United Nations (UN) organizations have been wrong before (e.g. Asian avian vaccine). And what are the pressures of multinational enterprises on national governments? Although it is recognized that food fortification alone will not combat deficiencies, it is a step towards reducing the prevalence of these deficiencies and their associated health conditions.

According to the WHO [11] one of the most serious global deficiencies is of vitamin A, which causes blindness in up to 500,000 children a year. However, beta-carotene, formerly just believed to be a pro-vitamin, is now known to be a vitamin on its own right and few studies have been conducted on this. The utilization of orange pulp sweet potatoes as a source of vitamin A and beta-carotenes is stimulated in Africa and is increasingly justified by NGOs and the companies that sell this product as beneficial [12]. Nevertheless, most African populations have access, for example, to chicken livers that contain per fresh weight 40 times more vitamin A than orange pulp sweet potatoes, according to our own calculations.

If malnutrition is to be sustainably reduced the solution needs to be holistic and inter-professional, and linked with agricultural, social, political, health and economic factors. Although traditional medicine plays an important role in health care delivery [13] and is the only source of health care that is available, affordable and accessible in about 80% of African community's international organizations statistics never include these data. Only food availability from production, imports and trade, using the distribution of consumption levels across the population, is used to estimate what proportion of the population is unable to meet its daily nutrient requirements. It is often stated in Sub-Saharan Africa that malnutrition percentage levels are frequently overestimated due to lack of knowledge of foreign experts on the use of traditional foods and medicinal plants and estimation methods [14]. For instance, estimates of the malnutrition prevalence could range between 5–18% and 14 - 48% for the same populations, in different studies [15].

The grouping of countries with the highest prevalence of stunting is found in southern and eastern Africa, reflecting a complex set of challenges that include civil conflict, economic downturns due to macroeconomic mismanagement or commodity price shocks, and droughts and floods, or the legacies of such events. It is important to note that in many of these hunger hotspots of malnutrition, food production is not the limiting factor. One such example is the Iringa region in Tanzania and central Mozambique where over 70% of the children are stunted in their growth, even though they represent food baskets for these countries.

The State of Food Fortification in Africa

The terminology is often confusing. In principle, "enrichment" means restoring the level of vitamins and minerals in a food to those approximating the levels found in the unprocessed material. "Fortification", by contrast, means increasing the amount of micronutrients to a level greater than that found in the unprocessed food. However, the two terms are often used interchangeably, even within the food industry. Adding thiamine, niacin, riboflavin and iron to flour is enrichment, whereas adding folic acid and calcium constitutes fortification.

The supplementation strategy certainly has greater specificity of intervention and allows better dose adjustment. However, its disadvantages are: incurred user cost, low compliance, self-prescription and increased risk of toxicity. Fortification strategy has the advantage of universality of the intervention and greater compliance. Drawbacks of the fortification strategy are: the dose is a function of food quantity consumed; lower specificity; and varying standards legislated for each country and quality control and regulatory challenges pertaining to fortification levels with the manufacturers of fortified foods.

Figure 1: *Some fortified food and beverages.*

Fortified eggs are achieved through the enrichment of folic acid in eggs by supplementing hens' diet. Milk is not accessible to all the population, edible oil is. Worldwide several strategies have been proposed to address the problem of micronutrient malnutrition. They include food fortification, dietary diversification, dietary supplementation, nutrition education, and public health measures. Although significant reductions in the high prevalence of micronutrient malnutrition will require multiple, complementary approaches, food fortification, is arguably the most cost-effective and practically feasible strategy over the near term.

Fortified Foods	Micronutrient
Salt	Iron, iodine
Wheat and maize flours	B vitamins, vitamin A, folic acid, iron, zinc
Cooking oils and fats	Vitamins D and A
Sugar	Vitamin A
Sauces	Iron
Milk	Iron, vitamins D and A
Complementary foods	B vitamins, vitamin A, folic acid, iron, zinc

Table 1: *Examples of fortified food and beverages with different micronutrients.*

It is evident that nutritional fortification of foods has been very effective in the past in eliminating widespread nutritional deficiencies mainly in developed countries. Fortification has been a major strategy aimed at improving the nutritional quality of the food supply in industrialized countries for many decades but has only recently been applied in many developing countries. As consumer health awareness and scientific knowledge increase, there is a great need for the fortification policies to be re-evaluated.

Several conditions are necessary for a successful national food fortification program. These include nutritional surveillance procedures to assess the prevalence of malnutrition and the shortfall of individual nutrients in the food supply; a suitable food vehicle that is widely consumed, especially by population groups most at risk for deficiency; centralized food-processing infrastructure, and technical expertise to ensure uniform addition of the nutrients to the food at low costs; availability of fortificants in forms that are stable to storage and cooking and that do not cause changes in the appearance or flavour of the food; suitable government oversight and quality control procedures to monitor addition to the food vehicle; an education program to inform people of the benefits of consuming fortified foods; and continued nutrition monitoring programs to assess the impact of fortification and to guard against excessive intakes of nutrients [16].

It is clear that many if not all of the above conditions are in place in most industrialized nations, many less-developed countries lack the resources to meet them, creating difficult challenges for implementing successful fortification programs. There are indeed strong

limitations to food fortification as it applies to developing countries and the novel approaches needed to overcome technical, nutritional, social, and economic challenges in these resource-limiting settings. Yet they have been implemented even with the lack of scientific reasoning but for mere profit in a growing business, in an indirect form of corruption.

A new promising approach is called biofortification. With this strategy, staple food crops such as rice, wheat, maize, and sweet potatoes are enriched with selected micronutrients through plant breeding. The nutritionally enhanced seeds are then distributed to farmers who plant them and harvest crops with increased micronutrient density. In our laboratory in Mozambique a parallel strategy was utilized to reduce mycotoxins production by replacing aflatoxin producing strains of *Aspergillus* by other similar fungus non producers of mycotoxins [17,18]. Biofortification is considered technically feasible and that the nutritionally enhanced foods can help to control micronutrient deficiencies.

Fortification of selected nutrients has been shown to have a significant impact on reducing child mortality, improving cognitive development, and raising economic status. The relatively low unit costs of food fortification along with the proven benefits to the quality of life of the poor in developing countries contribute to large benefit-to-cost ratios and justify the investments.

Fortified foods, such as corn-soya blend, biscuits, vegetable oil enriched with vitamin A, and iodized salt, are usually provided as part of food rations during emergencies. Such foods must be appropriately fortified, taking into account the fact that other unfortified foods will meet a share of micronutrient needs. Foods fortified with micronutrients may not meet fully the needs of certain nutritionally vulnerable subgroups such as pregnant and lactating women, or young children, who need special fortified formula.

In summary, it is clear that food fortification is one important tool for improving nutritional status in developing countries. Constraints such as adverse changes in sensory characteristics in the fortified foods and a lack of food-processing facilities for adding nutrients can be overcome by controlling the chemical reactivity of nutrients or using biofortification.

Types of food fortification strategies

There are 3 types of strategies [19] classified by who they are aimed at and how they are regulated:

1) Mandatory or mass fortification of staple foods, such as milk, cereal flour, when is mandated and regulated by a government. It is implemented when the majority of the population has a serious public health issue of being or becoming deficient in specific micronutrients;
2) Targeted fortification is the practice of adding sufficient amounts of micronutrients to provide large proportions of the daily needs through foods designed for specific population subgroups, such as complementary foods for infants and foods for institutional programs, such as those aimed at pre-school and school-aged children.
3) Market-driven or voluntary fortification is a prerogative of a food manufacturer who voluntarily adds one or more micronutrients to processed foods with the purpose of adding value to their products, thereby increasing marketability and sales. The micronutrient(s) added and the levels of fortification must be regulated by the government.

The safety of fortified foods and beverages

In the United States of America the FDA's policy neither encourages the indiscriminate addition of nutrients to foods nor considers it appropriate to fortify fresh products, meat, poultry or fish products, sugars or snack foods such as candies or carbonated beverages.

In the European Union (EU), there is an ongoing development in food legislation covering permitted additives ingredients and claims. The same applies in the supplement sector, considered in the EU as falling awkwardly between food and medicine - but treated within the food ambit.

An excellent example of unsafe fortified beverages is Coca Cola Diet Plus [20]. And several other fortified sodas. The latest in the list, however, is seriously unusual. The Coca Cola Company (who own or license and market more than 500 non-alcoholic beverage brands) produces Coca-Cola Plus which is essentially Coke with added fibre. Going on sale in Japan in 2017, the drink is sugar and calorie-free

and contains 5g of indigestible dextrin (per bottle, supposedly), which was created as a supplement for people with fibre deficiencies [21]. Besides there is a lot of excitement about the claim that the fibre could reduce fat absorption from food, if drunk whilst eating and according to Coca-Cola, drinking one bottle a day with meals will help control the levels of triglycerides in the blood after eating [22].

The drink besides being sweetened with a blend of aspartame and acessulfame potassium is a formulation of Diet Coke fortified with vitamins and minerals. Used in the UK, Brazil and Finland, is still available in 2017 in Japan.

Even drinking water has been the subject of fortification. Pepsi and Coca-Cola and other companies - Nestle S.A. (Switzerland), Groupe Danone (France), Karma Culture LLC (U.S.), Hint Water Inc. (U.S.), Kraft Foods (U.S.), New York Spring Water Inc. (U.S.), Sunny Delight Beverages Company (U.S.), Penta Water (U.S.), SkyWater Beverage Company, LLC. (U.S.) - market what is designated by "enhanced water". The marketing of "enhanced water" usually capitalizes on the healthful image of water combined with the perceived health, taste or functional benefits of one or more additional ingredients [23].

A product named "VitaminWater" is marketed by Coca Cola since 2007. In January 2011, the United Kingdom's Advertising Standards Authority (ASA) ruled that this beverage contained high sugar content (23g per 500 ml), about a quarter of a consumer's GDA (guideline daily amount), besides flavours and colours. Vitamin waters typically contain sugar and are experiencing a consumer backlash. Coca-Cola brand Glacéau Vitamin Water was sued in a class action challenging health claims that omitted the harm associated with 33g of fructose per bottle, almost the same sugar as a 310 ml cola [24].

Even tea has been used: a British startup has launched "Virtue Ice Tea", a canned drink fortified with vitamins and minerals that is sweetened with stevia [25].

Fortification is making tremendous progress in Africa. Countries often fortify wheat and maize flour as well as cooking oil, sugar, and salt as part of their comprehensive nutrition strategy. The Africa Maize Fortification Strategy 2017 - 2026 initiated its implementation and will supply further knowledge; however, we believe that fortification of just one commodity may not be the way to advance and it may just result in a huge business of premix sellers from developed countries [26,27].

Fortification Standards - Maize Meal in South Africa					
		Maize Meal			
Micronutrient	**Unit**	**Super**	**Special**	**Sifted**	**UnSifted**
Vitamin A*	µRE/kg	1877	1877	1877	1877
Thiamine	mg/kg	3.09	3.86	4.76	5.57
Riboflavin	mg/kg	1.79	1.88	1.97	2.06
Niacin	mg/kg	29.70	31.86	34.65	38.25
Pyridoxine	mg/kg	3.89	4.25	4.79	5.42
Folic acid	mg/kg	1.89	1.90	1.92	1.94
Iron	mg/kg	37.35	40.14	44.28	50.40+
Zinc	mg/kg	18.90	22.55	26.60	30.20

Table 2: *Fortification of maize meal in the Republic of South Africa.*

**Retinol equivalents (RE) = 1 µg retinol = 3.33 IU (International units) vitamin A.*

**Where special permission was granted in terms of regulation 10, a lower iron content of 34.65 mg/kg is allowed [28].*

Fortification of Sugar and Staple Foods

Since the latter part of the twentieth century, it has been questioned whether a diet high in sugars, especially refined sugars, is good for human health. However, not consumed excessively sugar provides a good vehicle for fortification as in most parts of the world, sugar

is an important part of the human diet, making food more palatable and providing food energy. Moreover, the daily intake of the carrier is essentially constant and the cost of the staple is economical.

Nevertheless, it is taking things too far to fortify sugar with vitamins to ensure kids and the vulnerable groups meet the daily requirements. Sure, kids in developing countries are said not to get the required amount of Vitamin A. At the same time it is unethical to fortify a food that has adverse health effects with vitamins just to meet the daily requirements.

Sugar is also known to be a high calorie food and processed sugar provides empty calories. High calorie foods lead to body weight gain, setting stage to a plethora of chronic health conditions including obesity and an increase to diabetes risk.

Severe vitamin A deficiency in association with protein-calorie malnutrition is often associated with high case-fatality rates. Due to this, multinational firms (e.g. BASF) bet on sugar fortification with vitamin and minerals as a common method to combat micronutrient malnutrition. The fortification of sugar with e.g. vitamin A is one of the safest, most efficacious, and most cost-effective interventions to prevent and control vitamin A deficiency. BASF has developed highly stable, bioavailable and affordable vitamin A formulations for fortification and special kits for the end-consumer to easily measure the Vitamin A content [29,30].

Nevertheless, by encouraging kids to take sugar at tender age just to meet recommended Vitamin A requirements sets the wrong precedent for the coming generations. Probably there are better ways of ensuring kids get the recommended Vitamin A by fortifying healthy foods such as milk, breakfast whole grain cereals, yoghurt and similar foods. In addition there are natural foods rich in vitamins which include sweet potatoes, carrots, sweet pepper, spinach and other green leafy vegetables. Tropical fruits abundant in Africa such as mango, pineapple, banana, water melon, papaya are very rich in vitamins, potassium, antioxidants, folate, pantothenic acid, potassium, magnesium and fibre which promote the health of natives without needing fortification. One of the highest vitamins in a banana is Vitamin B6 which keeps the immune system at its best. Actually half a mango will provide the recommended daily requirement of Vitamin A!

No country currently adds vitamin D to cereal staples. However, it is often added to complementary foods based on cereal and/or legumes targeted for children. Vitamin D deficiency is widely prevalent in Africa, despite abundant sunshine. Potential strategies have been proposed considering the diverse dietary practices necessitated by social, economic, cultural and religious practices and the diverse climatic conditions in Africa.

A mandatory food fortification policy and Law, usually on the basis of business interests, may be unacceptable in the initial stages, due to misconceptions and perceptions of the uninformed and uneducated masses. The option of voluntary fortification without a significant difference in the price of the product would certainly eliminate political reticence regarding fortification. Furthermore some countries interrupted the fortification programmes on the basis on price abuses on vitamins and premixes. But the question is: should a private industrial sector pay for a nutrition-public health intervention? The answer is that the consumer will pay at the end.

There are limitations to food fortification. Within the discussion of nutrient deficiencies the topic of nutrient toxicities can also be immediately questioned. Fortification of nutrients in foods may deliver toxic amounts of nutrients to an individual and also cause its associated side effects. In most African countries fortification will only result if included as an integral part of the Food and Nutrition National Plan that is with its costs being assumed by the public sector.

Concluding Remarks

In most Sub-Saharan Africa, food purchases are not influenced by consumer health concerns such as managing fat or cholesterol, reducing risk of a disease, defying the aging process, or following doctor's orders, as happens in developed countries. In general, fortification may increase the nutrient quality of food and drink, but may have little or no effect on public health. Unfortunately, few researchers have examined the effects of food fortification driven by industry on the national nutrient profile.

Also very useful are programs that include an income generation component to assist households in maintaining their ability to purchase foods and other necessities of life. Traditional therapies usually include the use of foods or herbs that are promoted as having healing or curative properties. Many of the traditional approaches are not well documented. The nutritional effects of traditional therapies, therefore, are not known.

African policy and programme responses include food-based strategies such as dietary diversification and food fortification, as well as nutrition education, public health and food safety measures, and finally supplementation. These approaches should be regarded as complementary ones, with their relative importance depending on local conditions and the specific mix of local needs.

Although fortification, either for profit or for health, has proven effective in treating nutritional deficiencies in the past, food fortification should support dietary improvement strategies and not be seen as an alternative strategy. From past success with fortification in other world regions, the key ingredients are formal cooperation among, government and industry, public education and epidemiological evaluation to assess the programme.

It is necessary to build the broad political will to address this issue and to foster the leadership necessary to effectively implement the solutions. What is needed is a strong commitment to these goals and dedicated efforts from authorities, policy makers, scientists, educators and traditional leaders, with budgetary allocations by central governments and development partners.

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