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Progress in Food Fortification in Nigeria - Historical Overview, Current Issues, Consumer Perceptions and Awareness, and the Need for Additional Vehicles

Ogunmoyela Olugbenga Ben*, Musa Obuluse Blessing and Oni Blessing

*Correspondence:

Consumer Advocacy for Food Safety and Nutrition Initiative (CAFSANI), 19b Military Street, Onikan, Lagos, Nigeria.

Ogunmoyela Olugbenga Ben, Consumer Advocacy for Food Safety and Nutrition Initiative (CAFSANI), 19b Military Street, Onikan, Lagos, Nigeria, Tel: +234 803 402 1641.

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ABSTRACT

It is already over two decades since the mandatory food fortification program, an industry-based micronutrient intervention initiative commenced with wheat flour, sugar, edible oils, and salt as the major vehicles. There is a need for comprehensive documentation of the historical overview of the initiative to give the right perspective and key learnings to guide similar interventions in the future so as to avoid 're-inventing the wheel'. It is also imperative to evaluate the impact of the program considering the huge investments that have been made by major stakeholders such as the government, industry, and various partners. The program impact after over two decades has appeared considerably low, especially with the huge numbers of the population still trapped in the malnutrition web, particularly within the targeted vulnerable groups. This is attributable to various factors such as poor communication and awareness, low inclusiveness of the informal sector, low consumer demand for fortified foods, poor industry compliance in the absence of government incentives, commoditization and poor stability of micronutrient premixes, paucity of funding for local research activities and training, as well as inadequate monitoring and evaluation, all of which are necessary for program sustainability and ownership. Results of an online survey of consumer perception, knowledge, and awareness of the food fortification program within the knowledge community confirm the case for additional mandatory food vehicles, particularly Bouillon cubes which have a wide reach in Nigeria. The rationale for the emergence of these additional vehicles, including rice and tomato paste is discussed to increase the coverage of the program. The need for a Code of Practice, to guide Producers towards better compliance is also discussed as part of the overall strategy to ensure that fortification vehicles reach the target population as expected for better impact.

Keywords

Food Fortification, Malnutrition, Nigeria.

Introduction

Emerging results, particularly emerging from the newly released 2021 National Food Consumption and Micronutrient Study, continue to affirm the state of malnutrition in Nigeria. The preliminary reports have indicated that the triple burden of malnutrition is still a public health concern, with stunting as high as 33.3%, wasting at 11.6% and underweight at 25.3% [1].

These indicators clearly show that many consume foods that are mildly or severely deficient in certain vitamins and minerals, and are evidences of a lack of dietary diversity, due to poverty, poor nutrition knowledge and food selection, as well as a high food insecurity of 79% [2]. Presently, vitamin A deficiency among the Nigerian population is reported to be about 40% - 50% among under 5 children while zinc deficiency ranges between 20% - 99% depending on the region of the country, with iodine deficiency reported at 1% - 10% based on food intake. These severities are estimated to have led to an estimated annual economic loss of

about US \$1.5 billion in Gross Domestic Product.

Various reasons have been adduced for why malnutrition still lingers in Nigeria. These include the increased poverty levels due to reduced earning capacity with 33% and 22% of women and men respectively in their productive age (15-49 years) having no form of education, the increasing population with a fertility rate of 6.0 [3], lower productivity due to high Disability-Adjusted Life Years (DALYs) [4], and sustained national economic crises in one form or another. There is also poor attention to funding of critical nutrition intervention programs, many of which are poorly designed, developed, and unsustainable but implemented with consequent loss of accessibility of the program to the targeted vulnerable populations. In some cases, there is cultural resistance and unwillingness to adopt or tolerate new changes or approaches, practices, and diets, all of which have limited the impact and success of many of these intervention programs. In fact, various nutrition intervention programs such as vitamin A supplementation, Biofortification, and Point-of-Use fortification, amongst others, have been met with various forms of resistance which could have been avoided with better communication and messaging, in local languages.

Food Fortification in Nigeria

Food fortification is now commonly accepted as a food-based intervention program in which micronutrients of public health importance such as vitamin A, iodine, iron, folic acid, and zinc are added to selected staple foods such as wheat flour, maize flour, sugar, salt, and edible oils. It is probably the most cost-effective and sustainable approach for preventing and addressing micronutrient deficiencies within population groups all over the world. Food fortification has the potential to leapfrog a population out of hidden hunger as well as increase their productivity, thereby breaking the vicious cycle of malnutrition and poverty. This impact can be observed in three key sectors of national development, namely education, health, and economy.

In addressing the myriad of micronutrient deficiencies in Nigeria, mandatory fortification of salt with iodine commenced in 1992 following the endemic prevalence of goiter. This intervention was a huge success as Nigeria was to be certified as the first African country to reach the milestone of about 98% coverage of iodized salt by 2005 [5]. In 2002, mandatory fortification of four selected food vehicles also commenced to address the increasing prevalence of vitamin A, iron, zinc, B vitamins, and folate. As this was a government initiative in which the foods are industrially produced, successful implementation required a coalition of partners, with relevant stakeholders drawn from industry, regulatory agencies, media and academia into a National Fortification Alliance under the leadership of industry partners and the regulators. Food fortification clearly has several advantages over other nutrition interventions. It does not lead to any disruption in the existing supply chain, it has a relatively low impact on production cost margins, and it does not lead to any changes in consumer behaviour. In the program design, it was expected that as producers began the implementation, the margin erosion of the retail costs would be negligible at only 0.1%-2.3% [6].

However, since the commencement of the program in Nigeria in the last two decades with significant commitments from all partners both in terms of finance and technical support including capacity development, provision of premix and testing kits, monitoring and other assessments, amongst others, several pertinent issues have yet to be fully addressed. These include the low impact of the program on the burden of micronutrient deficiencies, low consumer demand for fortified foods arising from the poor educational status and awareness of consumers on the benefits of the fortification program, poor reach and coverage especially in the informal markets, poor quality of premixes, low level of industrial fortification compliance, poor regulation at market levels, as well as low level of advocacy and communication support, all of which are required to stimulate increased consumer demand.

Historical Overview of Food Fortification in Nigeria

Historically, local industry led the first voluntary food fortification initiative in Nigeria as a competitive tool for market differentiation. The earliest of these initiatives, launched with fanfare as the voluntary fortification in the country, was Cadbury's Bournvita in 1994, after over four years of research collaboration with premix suppliers in conducting pilot trials and evaluating product outcomes. It must however be noted that Unilever Nigeria had prior to this introduced the Blue Band brand of margarine with added Vitamin D into the Nigerian market. These initiatives however pre-dated the release of the results of the 1993 national food and nutrition consumption survey in 1995, which showed the severity of Vitamin A deficiency in all the six geo-political zones of the country, with some communities in the North-West Zone showing as much as 61% Vitamin A Deficiency (VAD). Apart from this, other micronutrient deficiencies were also shown to be of concern, especially Iron, Iodine, and Zinc.

The endemic iodine deficiency characterized by a national goiter rate of 20% and less than 40% of households reached with iodized salt necessitated the mandatory fortification of salt with iodine in 1992. This kicked off the Universal Salt Iodization (USI) Program. There was a significant commitment from the government of Nigeria, the salt industry, and development partners, and subsequent revisions to the pre-existing salt standards, which led to the formation of the USI Taskforce. This task force ensured total compliance from the factory gate to the end user, and this was affirmed through the salt collection at the household level using school pupils. In recognition of this effort, Nigeria became the first African country to be certified as USI compliant having achieved a 98 % household coverage of iodized salt, a drastic reduction in goiter rate to 6%, and a median urinary iodine concentration of >130 µg/l between 1999 and 2004 [7]. This impact was evident in the significant reduction of the physical manifestation of iodine deficiency (goiter), which was hitherto prevalent within the population.

This encouraged more concerted efforts to address other micronutrient deficiencies of public health significance leveraging the success of food fortifications in many low and middle-income countries. This led to the birth of the industry-driven strategy and the Large-Scale Food Fortification (LSSF) Program, an initiative of various consortiums of international partners including UNICEF, USAID, Global Alliance for Improved Nutrition (GAIN), DSM, BASF, Bio-Organics Nutrient Systems Limited (BNSL), and Technoserve, amongst others.

An extensive longitudinal study was conducted to determine the suitable food vehicles in Nigeria with set criteria following which three other food vehicles were selected, in addition to salt, for the LSFF Program. These are sugar, edible oils, and flour (wheat, maize, and semolina). On February 26, 2000, the Vitamin A fortification program was formally launched in what has been termed the Abuja Declaration, with the "eye logo" having been launched shortly before in 1998. This paved the way for further discussions and subsequent development of the implementation framework, with industry partners resisting the program without any form of incentive, while the development partners continued to provide the much-needed technical support and push for a global commitment to eliminating micronutrient deficiencies in developing countries, including Nigeria. These partners, initially led by UNICEF, and later the Global Alliance for Improved Nutrition (GAIN), provided the technical and financial leadership in this regard with the support for the sourcing of premixes, dosing criteria, and capacity development in the form of laboratory monitoring for the industry, amongst others, while the Government of Nigeria provided the necessary enabling environment through the establishment of needed legislative framework and tax-based incentives. By September 2001, the industrial work plan for the implementation of flour, sugar, and edible oils, was ready in preparation for full commencement by the first quarter of 2002.

In 2002, the Honorable Minister of Health launched the National Policy on Food and Nutrition with the overall goal of improving the nutritional status of all Nigerians and importantly to seek the reduction of micronutrient deficiencies (principally vitamin-A, iron and iodine) by 50%, by 2010. Food fortification was one of the approaches considered in addressing these micronutrient deficiencies in combination with vitamin A and mineral supplementation, and dietary diversification. This provided the legislative framework and leverage for the successful program take-off. It also provided the premise for the development of other regulations, Codes of Practice, and other guidelines, as well as eventually securing the necessary commitment and buy-in of all partners and the facilitation of required advocacy engagements.

In furtherance to this, the Ministry of Industry, Trade, and Investment launched the revised version of Standards for Food Fortification with the assistance of UNICEF in February 2002. This was distributed by the Standards Organization of Nigeria (SON) to all stakeholders, including the industry partners. To ensure total compliance with the standards, SON through a press release in May 2002 gave a three (3) months moratorium to all importers and manufacturers of sugar, edible oils, wheat, and maize flour, for the commencement of the mandatory fortification of these food vehicles. Mandatory fortification of these products therefore eventually began on September 1, 2002, with all Flour Millers and Oil Refiners as expected.

In a similar endeavour to the earlier USI Taskforce initiative, under the \$3m GAIN-Sponsored Project on "Production, Quality Assurance, Monitoring and Evaluation, and Social Marketing of Fortified Foods" a coalition of stakeholders was formed, which was inaugurated early in 2007 by the Honourable Minister of Health for implementation with the National Agency for Food and Drug Administration and Control, NAFDAC, as the executing agency. This stakeholder coalition was to eventually transform into the National Fortification Alliance in December 2007 with the mandate to plan, implement, manage, and evaluate the mandatory food fortification programs in Nigeria. The alliance comprised representatives of the government agencies (SON, NAFDAC, FCCPC), Flour Millers Association of Nigeria, International development partners, the Association of Food, Beverage and Tobacco Employees (AFBTE), Oilseeds Processors Association of Nigeria, Academia, Media, and Civil Societies and was eventually inaugurated in April 2008.

The first monitoring and verification assessment visit to various industries was conducted to assess the level of compliance of premix importers and manufacturers of flour, sugar, and edible oils in April and May 2003. This first verification visit was jointly held by SON and NAFDAC. As reported by Akinyele [8], the compliance was only at 5%. The summary of other compliance assessments is presented in Figure 2 as reported by Ogunmoyela et al. [9]; NAFDAC in 2015 and 2017, and by Sahel Consulting in a comparative program cost assessment in 2019. The reports showed that compliance had been uneven and was yet to reach the expected 100%. As estimated by Sahel Consulting in 2019, to attain 100%, there was a need for an industry-wide investment of 55m USD per year.

Concerted efforts to strengthen compliance at the industry level, led to the development of a comprehensive manual on Inspection, Sampling, and Testing of Fortified Foods, which was drafted in September 2009. This was based on the revision and harmonization of existing protocols, guidelines, and procedures of SON and NAFDAC under the GAIN Project. By May 2010, a capacity development and training workshop was held for laboratory personnel on the Harmonized Manual for Laboratory Analysis and Testing of Fortified Wheat/Maize flour, Sugar, and Vegetable oils.

Following the results of the first LSSF survey published by Ogunmoyela, the standards for Wheat/Maize flour and Semolina were revised to include folic acid and zinc, while codes of practice for premixes and for fortified flour were introduced by the Standards Organisation of Nigeria. These became necessary following the growing concerns on the poor industry compliance to fortification standards and the importance of the program to addressing public



Figure 1: Historical brief of Mandatory Food Fortification in Nigeria.

Source: Busari, A. K. (2013). Two decades of food fortification in Nigeria: Situational Analysis, Hubert Department of Global Health, Emory University, Atlanta, Georgia, USA.



Figure 2: Levels of Fortification Compliance in Food Vehicles.

health issues in Nigeria. This revision was done in June 2015 with an inclusion ratio of 1.5mg/kg for folic acid and 20mg/kg for zinc. However, this is only applicable to wheat semolina, wheat flour, and maize flour. The consumption of locally produced, nonpackaged maize flours and vegetable oils still thrives in many rural communities in Nigeria. A large proportion of these rural populations are challenged by vitamin A and other micronutrient deficiencies as these products are milled at the household level and consumed without being fortified. In addressing this gap, GAIN in November 2010 supported the successful commissioning of a cottage processing plant for point-of-use fortification of maize flour and vegetable oil for small-scale producers in Yola, Adamawa State. Local millers from the neighbouring communities brought in their milled products for fortification and assurance of the State Government was secured for the sustainability of the initiative after the project implementation phase. However, by the end of this first phase, government support was not secured as promised, amidst other contradictions, including cultural resistance. Thus, the plan to extend the initiative to Kano State had to be abandoned even after procurement of the processing plant, and this led to the eventual failure of this initiative, which should by now have been replicated in several other rural communities outside of the formal sector for impact.

In 2012, UNICEF and GAIN donated Diagnostic i-Check devices for rapid Quantitative Analytical Testing of vitamin A in fortified products which had been developed by BioAnalyt GmbH (Chroma for vegetable oil) and (Flouro for flour) to strengthen the monitoring activities of NAFDAC and SON at both market and industry levels respectively. Training support for the regulators was also provided at Stellenbosch University in South Africa with the support of DSM. A high-level strategic meeting of stakeholders on food fortification was held in March 2013 to evaluate the impact of food fortification in Nigeria as well as chart a new course for the program that would be more holistic, effective, and impactful. This was sequel to the preliminary report of the LSSF survey conducted in 2012, and the concerns raised by the results. National surveys, including the TechnoServe report in 2019, have suggested that more food vehicles should be considered as not all households are reached with the existing food vehicles. Moreover, emerging statistics show that the impact has not significantly contributed to the reduction of micronutrient deficiency with many communities still trapped in the malnutrition web. The "Fortify Food Group", a U.S.-based, not-for-profit organization with the mission to save the lives of women and children who suffer from iron deficiency, made a presentation in 2015 to a team of nutrition experts with the United States Agency for International Development (USAID) in attendance, including senior nutrition scientist, Dr. Omar Dary. At this meeting, the group made a case for the adoption of tomato paste as an iron delivery food vehicle in Nigeria. This was on a premise that most households use tomato paste for cooking. USAID suggested that GAIN should conduct a feasibility study for the adoption of tomato paste, as well as the supporting data on consumption patterns. GAIN, in 2018, released the findings of the study, which confirmed the widespread consumption of tomato paste. The result also affirmed the potential of the product as a

vehicle for iron fortification. This result was also presented to a Nigerian tomato stew company based in Lagos. The Fortify Group has since commenced discussions with the Nigerian processing community to develop an iron-fortified premix for institutional buyers.

Current Challenges limiting the impact and success of food fortification program in Nigeria

The fortification program has made a limited impact, while coverage reports have been below the expected target when compared to the investments made in the last two decades. Chadare et al., in 2019 [10], having reviewed several research efforts in various countries, noted that the absence of highlighting the importance of food fortification in national policies has negatively impacted the program thereby limiting the significance of the program or contributing to addressing nutritional challenges. Similarly, as the intervention is solely industry-based, the foods do not really reach the poor who are most vulnerable and have a low purchasing power to be able to afford these foods. This segment of the population is known to grow and process their foods within their communities.

Industries in the voluntary fortification space such as Cadbury, Friesland Campina, and Nestle, have always taken full ownership of their food fortification initiative by ensuring full compliance to approved standards and have been able to take full benefit of the added nutrients as a marketing tool for communicating with their customers. This has ensured that the program is sustained to date. However, the reverse is the case for the mandatory food fortification program as there is no perceived comparative advantage that this initiative has added to their trade and businesses, particularly their profit margins. Although it is a mandatory program, it is yet to be accepted as a corporate social responsibility to support the government in the fight to reduce or eliminate malnutrition. This has negatively affected the program as the benefits of consuming fortified foods are not well communicated to the consumers to stimulate a market-driven demand, especially in rural communities or in local languages.

The incentive of a 5% duty tax rebate for implementing food fortification was also poorly communicated to the industry associations at the onset of the program, except for the Flour Milling Association of Nigeria, FMAN which was able to take advantage of the incentive for the first five years of the program. In view of the sector-wide approach, there was no perceived direct benefit to individual industries to foster special attention to compliance. This has further contributed to the lack of ownership of the program to date except amongst the major flour millers. Similarly, the government has also not clearly mapped out any advocacy program or communicated the benefits of food fortification to the consumers that will ensure increased consumer demand for fortified foods. There is also poor communication between government regulators on logistics of handling of premixes which have continually affected the quality due to delayed clearance at seaports in our tropical environment of high temperature and humidity. Nevertheless, the efforts large-scale industries in the Flour Millers Association of Nigeria (FMAN),

Sugar Millers Association of Nigeria (SMAN), and Oilseeds Processors Association of Nigeria (OSPAN) have sectoral received commendable self-coordination and self-monitoring activities through the roll out of the Micronutrient Fortification Index (MFI) developed by Technoserve under the Strengthening African Processors of Fortified Foods (SAPFF) project initiative. With frequent monitoring by the regulatory agencies as well as registration with the NFA, the MFI enrolment must be seen as a significant positive development for promoting self-regulation and individual company benefits in the country. This is not the same for the Micro, Small, and Medium Enterprises (MSMEs), which are also critical to the success of the program but many of which are not covered in the implementation monitoring as they are usually not easily traceable. The cost of the technology, including the initial cost of the dosing equipment, the price of the premix, achieving and maintaining an adequate quality assurance system, as well as sustaining monitoring and distribution systems, could be a deterring factor for many SMEs as well as the lack of centralized food-processing units within the communities which could have supported the SMEs in fortifying their products. The absence of a culture of cooperation between the small players is also a major hindrance to progress in this direction.

Inadequate testing has affected the monitoring of fortified foods at all levels. Food samples are not adequately tested as there is limited testing facility and personnel capacity in the country. The regulatory agencies still have centralized laboratories which delay the turn-around time of tested results which are needed for critical decisions to be taken at various times. Discussions are however ongoing on the possibility of sub-contracting to private laboratories that have the required capacity and infrastructure. Most local industries also lack critical in-house laboratory testing capabilities that would have enhanced their in-house compliance monitoring. The consequence of all this is the promotion of capital flight as samples have to be shipped out for testing in other countries. There is therefore an urgent need for the government to decentralize the testing laboratories of the regulatory agencies, and assist in strengthening the capacity of private laboratories to get them accredited to provide the required support to regulators. This is a clear pathway that has been successfully implemented in other countries. As part of efforts to address the gaps in this sector, GAIN in 2021 in partnership with the Institute of Public Analysts (IPAN), provided support for ISO 17025 certification of three private laboratories and three public sector laboratories, apart from initiating an e-learning program "The Institutionalization of Laboratory Analytical Capacity Development" (ILACD) project. It is expected that the benefits to local industries and analysts undertaking this program will help to strengthen local micronutrient testing capacity in the foreseeable future.

Industries have unfortunately continually faced with severe cost pressures, including taxes, power, maintenance, and economic issues, which erode profit margins thereby forcing industries to focus more on price rather than quality. The measures often applied tend to weaken the quality system, especially in terms of standards compliance and quality of the prescribed premix addition rates from time to time. Thus, rather than using fortification as a consumer incentive to drive sales, create demand, build customer loyalty, and increase market share, the corollary continues to be the case, with a challenge to ensure that quality is consistently optimized and maintained.

The continued reliance on external initiatives, including the importation of premixes, and dependence on the GAIN Premix Facility for the supply of fortificants to local industries, is seen as a disincentive to the growth of local businesses and research opportunities, thereby hindering local ownership and integration as well as promoting economic dependence. This further jeopardizes the sustainability and institutionalization of the program. Local suppliers therefore resort to cruel price wars and commoditization of the premixes rather than quality orientation. This absence of a standardized control system for local suppliers has led to the infiltration of the market with poor quality and low standard premixes. This has forced many industries to patronize only foreign suppliers who are trusted and can guarantee the quality and standards required. These concerns will need to be urgently addressed to sustain and improve the quality gaps in the fortification value chain.

There is an absence of local investment in funding and research activities that will sustain the initiative which are necessary to ensure the continuity of the program and promote ownership and self-regulation. Local research that supports the development of sustainable mechanisms for quality assurance is also obviously lacking. For instance, the initiative to develop a compliance index with the use of gluten index for flour containing 10% cassava flour, which was led by SON in the early days of the cassava initiative remains unattainable in the face of lack of investment in research. This is also the case for advocacy for the use of rapid qualitative testing for fortification compliance, which was led by BASF SE Nutrition, but these initiatives have never been conclusively realized, because of insufficient investments in research and development due to perceived lack of immediate benefits and the absence of any long-term strategy.

Addressing the Broken Fortification Value Chain

The investment, including technical and financial, made into the fortification agenda in Nigeria can only be effective when the limitations in the value chain have been addressed by all relevant stakeholders. This requires a clear and well-coordinated approach. The program design and implementation therefore need a critical review to address the gaps in the design and implementation phases of the program as have already been highlighted. The overriding assumption of inclusiveness of the informal sector in initial program design has not been met, due to the limited consumption of processed and packaged foods in the rural communities and the significant absence of regulated and fortified food vehicles in the informal sector of the population. For instance, the 2015 GAIN Fortification Assessment Coverage Toolkit (FACT) Survey report showed that of the 77% population in Kano reached with maize flour, only 11% consumed maize flour in its fortified form [11] and nationally, less than 1% [1]. The over-reliance on legislation in the

face of poor communication and awareness, as well as the absence of consideration for, and engagement with Small and Medium Enterprises, who are very critical to the economy as they account for about 51% of the production sector also need to be addressed. There is a need for incorporating planned periodic impact assessments and monitoring of food consumption in the form of well-coordinated national food consumption and micronutrient surveys. The last one was held in 2001 before the recent 2021 study. There is no doubt that the just concluded national survey will be useful in reshaping and developing an improved roadmap that will guide the structuring of the various programmatic steps in the fortification program cycle (Plan-Do-Check-Act) with key decisions to be implemented. Results obtained are expected toe useful quantitative evidence that will drive or reshape the fortification programs as may be necessary.

Industries have continuously relied on the non-existence of an enabling legislation that makes it compelling to mandatorily fortify or be prosecuted for derailment. The creation of a clear enabling legislation is, therefore, necessary to back up the already established national standards and regulations as a way of ensuring the commitment of succeeding administrations to the agreed fortification roadmap. Initiatives like this without legislative commitments are usually abandoned or selectively implemented according to personal or individual leadership interest, persuasion, or preferences in governance. The existence of such legislation is expected to stimulate or create a sustainably creative incentive or reward for individual industry compliance to fortification regulations and guidelines rather than the current blanket sector-wide approach. The government must also as a matter of urgency, provide the much-needed revised and more specific and measurable framework for addressing malnutrition and micronutrient deficiencies in the country. The multiple and overlapping interventions, multiplicity of agencies with short-term interests, and a lack of concern for consumer benefit, also clearly show the need for an evidential coordination of the activities of various partners in the fortification and associated programs. A clearing house for programs such as fortification and other related aids will therefore be necessary.

Compliance Issues

The initial reports of high levels of compliance from the first monitoring and verification assessment that was jointly conducted by SON and NADFAC were not supported by the results of the LSSF survey reported by Ogunmoyela et al. Hence, there seems now to be an agreement that the compliance level of mandatory fortification in the country is low. The food industry plays an important role in the fortification program as fortification is done at industry level. National compliance reports including the Global Fortification Data Exchange (GFDx) have reported that there is a below-standard compliance as shown in Figure 1 above, of fortified food products despite the selection of staple foods (flour, oil, sugar, salt) for mandatory fortification [12-15], with salt (94.6%) being the most compliant fortified product and maize flour as low as 30%. This has similarly affected the impact of the intervention as the intended nutrients are not delivered to the target population in the desired dose or quality with the consequence that vitamin A deficiency is still prevalent, particularly among women of reproductive age (WRA), and Under-5 children. The sustainability of the fortification program for wheat flour, maize flour, sugar, and vegetable oils will require better compliance to the required standards. The fact that many food products under mandatory fortification are found to be inadequately fortified, or even unfortified when rapid assessments are conducted in the markets should be of serious concern, as it will continue to hinder the impact of the food fortification program in fighting Nigeria's high prevalence of micronutrient deficiencies.

The need for stronger regulatory enforcement as well as the provision of an enabling environment in our markets to ensure the mandatory program achieves its objectives with greater impact and coverage cannot be over-emphasized. This is the only way to guarantee the sustainability of the program. Increased communication and awareness will change consumer perceptions, especially in the rural areas. Different strategies can be used to involve different actors to drive and create awareness with evidence of impact, which is critical to the buy-in of the program.



Figure 3: Trend of Salt Compliance over selected years.

It is imperative to note that fortification is consistently achieved with high quality and is more sustainable when implemented in a modern or upgraded processing facility. To support compliance at industry level, development partners led by TechnoServe (TNS) through the Strengthening African Processors of Fortified Foods (SAPFF) program funded by Bills and Melinda Gates Foundation (BMGF) also instituted an industry self-evaluation activity, which has since been endorsed through the annual CEO Forum, as a coalition of the Nigerian Food Processing Industry and the Nutrition Leadership Forum [16]. As already explained, this selfregulatory process technology, Micronutrient Fortification Index (MFI), was premised on a tripod of Self-assessment (SA) - 60%, Periodic independent testing of products -20% and an evaluation by the Industry Expert Group (IEG) -20%. The assessment puts more performance responsibility on the industry to meet up to a minimum 60% mark, which confers a mark of quality excellence on the fortification process and product. This technology developed with adaption from the Food Fortification Index.

The MFI was officially launched on 16th September 2021. While more and more industries are expected to voluntarily enrol into

the program, it is expected that industry stakeholders will use this self-regulatory tool to raise the bar of quality nationally in the long run. In improving compliance along the supply chain, more technological innovations are also being pursued to improve quality assurance and control. One of these is the digital quality system, which is presently nearing completion under the GAIN Digital Quality Assurance and Quality Control Systems Project. This is a user-friendly system already adapted to the country's context. It is expected that these systems when developed and in use will enable industries and authorities to generate, govern, share, and utilize real-time, accurate, secure, and traceable data on food fortification quality from factories to markets. This will also facilitate a strong partnership between the regulators and industries in ensuring compliance to quality that will ensure a successful implementation of the program. The pilot implementation phase of this system initiative is expected to run up to 2025.

Whilst it is worthwhile to have the various measures of monitoring and improving compliance within the country's fortification framework, setting of standards should always be country-specific and not just in line with the guidelines and regulations of the CODEX or World Health Organization (WHO) as there are several factors that will influence these standards. A major consideration should be the per capita consumption of the population that will ensure safe and effective delivery of the fortification objectives. This is why recent ECOWAS regional harmonization initiatives should be embraced as a very significant step in the right direction.

Consumer Perceptions and Awareness

Over the last two decades, the mandatory food fortification program in Nigeria has been beset with various challenges that have limited the expected positive impact on the nutrition status of the population. These include poor compliance, low capacity for analysis of products, premix pricing, and quality, poor regulatory capacity for monitoring, limited coverage, poor research support, and low consumer reach as evident from various surveys and reports. The consequence, therefore, has been that voluntarily fortified product brands supported by corporate advertisements in various forms, are better compliant and better known to consumers. CAFSANI therefore conducted an online baseline survey to understand the level of awareness of fortification and consumer perceptions of fortified foods, as well as to unravel the reasons why there is low consumer demand for fortified products. The objective was to understand the present fortification landscape in view of the imminent introduction of additional fortification vehicles such as Rice and Bouillon, which have wider household reach in Nigeria.

A total of 70 responses were received in an online survey conducted within the food, nutrition and agriculture community using a descriptive multiple-choice questionnaire. Respondents comprised 43% male, and 57% female, across different age groups (<30=17%; 31-45=56%; 46-69=24%; >70=3%). However, because of the knowledge community in which the survey was conducted, 100% of the respondents had attained a tertiary education level but of these, only 71.4% were skilled professionals, while others

were unemployed (7.9%), traders (6.3%), students (6.3%), farmers (4.8%) and others (3.3%). 81% of these respondents were in urban areas, while 14.3% were in semi-urban and 4.8% were in rural areas. However, on access to nutrition information and awareness of fortified products, the survey revealed the level of consumer knowledge and interest in fortified foods. Figure 4 shows that the media (electronic, print, and social) accounted for 85.7% of the respondents' sources of information on nutrition, followed by radio jingles (9.5%), town criers (3.2%), and wordof-mouth (1.6%). Figure 5 shows that 65.1% of respondents know what fortification really is and what it means, while 34.9% of respondents believe that the addition of essential micronutrients to a product is either a form of dietary enrichment, supplementation, or food replacement. Figure 6 shows 81% of respondents stated that they base their purchase decision on any product on the product nutrition information, while 19% choose to disregard it and still believe that they make an informed decision. From Figure 7, it is clear that 57.1% of respondents inquire about the nutritional composition of the food they purchase from retailers/marketers, compared to 42.9% who do not. In a previous study conducted randomly in open markets, Ogunmoyela et al. 2021 [17] found that purchase decisions were based on three key parameters, namely brand name, price, and the Best Before date, which inform the way the packs are displayed on the shelves. The results obtained here reflect the high knowledge level of respondents.

Nevertheless, 87.3% of the respondents confirmed that their food purchases are made at open markets, while 12.7% make purchases at neighborhood stores and supermarkets (Figure 8). Generally, it is expected that the information displayed on the front label of a product will guide the consumer towards making the right purchase decision. When respondents were asked if other information on a front label would influence their decision apart from brand and price, 69.8% confirmed that they are influenced by other information, while 30.2% do not consider other information on a label in making any purchase decision (Figure 9).

Even though the mandatory food fortification program started in Nigeria more than twenty years ago, Figures 10 and 11 from the survey showed that only two out of three (66.7%) of the 63 responses admitted that they have seen a fortified product, while 33.3% have not, and only 78.6% of the respondents could identify a fortified product by its logo or symbol. Figure 12 shows that 22.2% of respondents believe that bouillon is one of Nigeria's mandatorily fortified products, while a high number of 66.7% of the respondents have knowledge of salt being fortified, and only 11.1% believe that biscuits are mandatorily fortified. In response to whether there is a need for the fortification of additional food vehicles, 84.1% of respondents agreed that more products need to be fortified, while 15.9% believe there is no need (Figure 13).

In the study of consumer perception and awareness of the need for fortification of additional vehicles, especially bouillon cubes, figures 14-19 show that 71.4% of respondents were familiar with bouillon products while 28.6% were not (Figure 14); 57.1% who are the females who do the household cooking confirmed that





Figure 4: Common sources of information.

The addition of essential micronutrients that are not present to a processed food is best described as:

63 responses



Figure 5: Respondents' knowledge level of fortification.

Does nutrition information guide your purchase decision? 63 responses





Do you ask retailers/marketers any questions about the nutritional composition of foods before you purchase them?

63 responses



Figure 7: Market inquiry about nutritional composition of food before purchase.

From which outlets do you make your food purchases? 63 responses





Apart from Brand name and price, will other information on the front label display influence your purchase decision?

63 responses



Figure 9: The influence of other information on the front label on decision-making.

Have you seen any products that are fortified before? 63 responses



Figure 10: Knowledge of respondent of fortified product.

How do you know the above listed products are fortified? ⁵⁶ responses



Figure 11: Means of identification of fortified product.



Which of the following Processed products are under Mandatory Fortification in Nigeria? 63 responses

Figure 12: Food vehicles under mandatory fortification in Nigeria.

Do you think there is a need to fortify more food vehicles in addition to the existing ones? 63 responses



Figure 13: Consumers' perception of the need to fortify more food vehicles.

they use bouillon cubes for household cooking while 42.9% (male respondents) do not use bouillon cubes (Figure 15). 54% of respondents agreed that fortified bouillon cubes would be a better complement to the existing fortified food vehicles, while 46% disagreed (Figure 16). It is notable that a significant number of respondents (77.8%) are not aware of the pre-existing voluntary fortification efforts of manufacturers of major brands on bouillon cubes, while only 22.2% had such knowledge after almost one decade of iron fortification (Figure 17). It was clear from the survey that respondents believe that there is a need for improved or special communication channels to address the low level of awareness about bouillon cubes with 88.9% of the respondents affirming this, while only 11.1% disagreed (Figure 18). 82.5% of the respondents suggested that social media would be the best way to spread the word about bouillon cubes, while the remaining 17.5% chose expert opinions, industry communication, door-todoor marketing, billboards, fliers, and jingles (Figure 19).

Unfortunately, as has been revealed in this study, a large segment of the population is still unaware of the importance of fortified products to their health and nutrition. The likelihood that a consumer will consider nutrition information when making a purchase is low, which highlights the need for more effective and efficient strategies to raise awareness among stakeholders, government, policy agencies, and nutrition intervention programs. The high degree of knowledge and awareness of fortified products as confirmed in Figure 14, is in agreement with the report of Petra et al. 2018 [18]. However, despite the high level of knowledge and use of bouillon cubes in household cooking, there is little information about the fortification efforts on bouillon cubes (Figure 17). Overall, 84.1% of respondents in this survey indicated that more food vehicles should be fortified, in addition to the ones already under mandatory fortification, hence the case is made for bouillon cubes which have the widest household reach as an additional vehicle, especially for micronutrients which are stable under various tropical environmental and cooking conditions. If adequately supported with the right level of advocacy and communication to create the required level of consumer awareness, it promises to have a significant advantage as a vehicle for ameliorating micronutrient concerns in vulnerable population groups and increasing the market demand for fortified bouillon cubes and other products. Ultimately, it should be expected to translate to an overall improvement in the nutritional status of the population as already predicted from micronutrient modelling (mini-mod) evidence [19].

Current Issues

Recently, the Standard Organization of Nigeria (SON) revised the specification of vitamin A premix being used for vitamin A food vehicles. This revision was on the premise of quality and stability, in-process addition challenges when compared with the World Health Organization (WHO) guidelines, as well as losses during handling, storage of flour, and food preparation. For instance, there is an estimated 15% loss of vitamin A during handling, storage of flour, and food preparation.

This was similar to findings reported by Uchendu and Atinmo [20] where the quality of wheat flour obtained from traditional markets, which are usually openly displayed under the sun, in Lagos depreciated after months of storage. The quality after three months is less than 22%, this clearly shows that storage and stock keeping procedures affect the quality of the Vitamin A in these products. This portends a risk to this intervention considering the instability of the economy and increasing inflation as vendors are likely to stock more products irrespective of the storage facility available. Further research may be necessary to determine the quality of fortified foods that are delivered or available at household levels while awareness creation activities on storage must also deployed at market and household levels. Industries may want to consider the establishment of decentralized storage facilities that will ensure that products are readily available and easily mopped up, not as a result of expiration but losses in Vitamin A quality. However, this can only be possible when industries accept food fortification as a corporate social responsibility and seek the good of the consumer in addition to their profit motive. This is also a challenge for local researchers on the formulation of vitamin premixes that will assure quality retention over a longer period.

The rapid loss of vitamin A stability also affects fortified edible oils especially when exposed to light and unhealthy storage conditions. TechnoServe reported that fortified oils when exposed to extreme light conditions, recorded a significant loss in quality Do you know what products are known as Bouillon cubes? 63 responses



Figure 14: Test of consumers knowledge of bouillon cubes.

Do you use Bouillon cubes for cooking in your household? 63 responses



Figure 15: Consumers use of bouillon cubes in household cooking.



Do you think Bouillon cubes will be a better complement to the existing food vehicles? 63 responses

Figure 16: Bouillon cubes as complement to the existing food vehicles.

Are you aware of current fortification efforts on Bouillon cubes? 63 responses



Figure 17: Awareness of current fortification effort on bouillon cubes

Will you suggest that a special communication channel be activated for the fortified Bouillon cubes?

63 responses



Figure 18: The need for special communication bouillon cubes.

What mode of communication would you suggest for effective consumer awareness creation for fortified Bouillon cubes? 63 responses



Figure 19: Mode of communication for effective channel for consumer awareness creation for bouillon cubes.

of >50% within four weeks [21]. However, a new technology being promoted by the EDCEL Limited seeks to address this gap as well as ensuring that oils can be fortified at the point-ofuse, particularly when there are already established reports of low compliance and absence of fortification at small-scale and cottage mills of edible oils. Through this technology, there is greater possibility of fortifying oils by small-scale millers without the necessary requirement of understanding the technicalities of fortification and procurement of dosing equipment.

In 2015, as already reported, there was a major revision of the specification of form of iron used in cereal flours. This was to improve the bioavailability of iron. It was therefore changed from electrolytic iron to sodium iron ethylenediaminetetraacetic acid (NaFeEDTA). Similarly, the specification for level of the Vitamin A in the premix used in cereal flours was revised downwards from 10mg/kg to 2mg/kg due in line with the harmonization of standards in the region on the basis of per capita intake, in addition to the inclusion of zinc and folic acid. It is comforting that the preliminary results from the 2021 Food Consumption and Micronutrient Survey have not suggested the occurrence of hypervitaminosis due to multiple nutrition interventions, including the promotion of diet diversity as had hitherto been expressed

as a concern. In the current discourse on the opportunities for promoting workforce nutrition in Nigeria, the need to leverage the existing mandatory fortification program, has been suggested [22].

Fortification Coverage

Over the years, nutrition interventions, including food fortification, have been limited by poor coverage as many areas have not been reached with fortified foods. Partners choose selected States for their interventions, while national coverage is a challenge even for national programs due to logistics and cost. This was evident in the report of Fortification Assessment Coverage Tool (FACT) Surveys of 2015 and 2017 respectively, undertaken in Kano and Lagos, and Ebonyi and Sokoto, as shown in Figure 20 [23,24]. The recently released national food consumption and micronutrient survey affirmed that less than 50% households are reached with fortified foods (Vegetable oils – 33%, Sugar – 22%, Wheat flour – 13%, Maize flour – less than 1%, Semolina flour – 23%, Salt – 47%), while only bouillon cubes which are voluntarily fortified has 96% coverage has represented in Figure 21 [1].

Other factors attributed to this trend include poor knowledge of consumers on fortified foods and its importance, the disruption of



Figure 20: Results from FACT Surveys - Coverage of fortified foods across selected geo-political zones in Nigeria.



Figure 21: National Coverage of Mandatory and Voluntary Fortified Foods.

the supply chain especially during the COVID-19 pandemic, low consumer demand, low purchasing power, and choice of point-ofpurchase, as many households make their food purchases at the informal traditional and open markets. Of course, the continued consumption of home-made unfortified foods, due to affordability issues as well as the absence of any advocacy and communication activities on specific benefits of fortified foods, leave many households still reliant on the purchase of grains such as wheat and maize to make into flours for consumption.

Possible Additional Food Vehicles

As already highlighted, based on the consumption patterns of the vulnerable groups, which are the target groups of this intervention, it has long been suggested that there is a need to include add more food vehicles to the existing ones [25]. Under-5 children and Women of Reproductive age are mostly affected by micronutrient deficiencies. Food consumption studies have shown the preference for some foods by these groups in many Nigerian households. The additional foods being considered for fortification include rice, which is to be fortified with Iron, Folic acid, and Vitamin B12, with the aim of addressing iron deficiency and spina bifida in children and anemia in women in their reproductive age in the country. Arrangements to commence this program have reached an advanced stage with the development of the Code of Practice by the Standards Organisation of Nigeria for the intervention. A recent study by GAIN [26] further highlighted the consumption, coverage, acceptability, and affordability of some foods. Apart from rice, it was suggested that bouillon cubes and tomato paste have great potential to be added to the existing food fortification vehicles. Helen Keller International, with the support of the Gates Foundation, is already promoting the bouillon fortification initiative in Nigeria, Senegal, and Burkina Faso, through discussions with Country Working Groups across the three countries and engagement of global bouillon industry partners. Experimental trials are currently ongoing on the feasibility of adding Iron, Zinc, Folic acid, Vitamin A, and Vitamin B12 into bouillon cubes. Modelling studies have suggested that these recent rice and bouillon initiatives, when realized, may yet be the 'game changer' in the efforts to address hidden hunger in this part of Africa, because of the wide reach and household coverage, which has been estimated at 95-98%.

Conclusion

The development of a multi-dimensional roadmap that will effectively address all the various concerns already identified in fortification program design and implementation has become quite imperative now. This will require a stronger commitment from all stakeholders, whether in government, business, research community, or partners. The success of this initiative will also depend on the commitment of a revamped leadership of the National Fortification Alliance to generate new ideas for sustainable funding, as well as advocacy efforts.

Awareness communication and government-led advocacy on the prevalence and consequences of hidden hunger need to be targeted at all stakeholders, including consumers, including the predisposing factors that put populations at risk. Industries must be encouraged to see the necessity of voluntarily supporting the fortification program as a corporate social responsibility. This will include the obligations of premix suppliers.

Capacity-building efforts must also be intensified to better equip regulators. This will include addressing the current challenges in program design, implementation, advances, regulatory framework, testing capabilities, monitoring and evaluation, and promotion of voluntary compliance through self-regulation, apart from stiffer penalties for non-compliance. This will also require that the government provide the required leadership through an enabling and responsive investment environment that will promote the goal of ensuring a healthy population in all ramifications.

Support must also be given to the need for creatively providing suitable infrastructure and building local capacity for a food production and processing system that will ensure the stability of fortified foods in trade. These efforts will improve the nutrient composition of foods available, improve market access to safe and nutritious foods, and influence the food habits of the affected and vulnerable groups, especially in the informal food supply sector. After over two decades, it is clear that the program has come a long way, but all stakeholders, especially the industry actors, must now take ownership and be interested in ensuring that this initiative is integrated into their systems to ensure sustainability in the new world beyond partners' support. This will necessarily include improving the interface with consumers through more impactful messaging and communicating the benefits of fortification to increase consumer awareness, demand, and monitoring. The need to urgently capture the small-scale entrepreneurs, who have been left behind, but remain critical to the success of this program, must also be part of the new roadmap, while consideration of local innovations that will support the activities of both the large and small-scale industries must be developed. For this to happen, increased investments in research must be prioritized while foods that are affordable and available to all consumers, even the poorest of the poor, are considered for fortification at small-scale and cottage levels.

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