MAPPING OF INDUSTRIALLY-PRODUCED TRANS-FATTY ACIDS (iTFA) IN NIGERIA

A report on sources and replacement solutions for iTFA in Nigeria

March 2020

#BetterNutrition4All

Scaling Up NUTRITION

Business Network
ENGAGE • INSPIRE • INVEST

gain
Global Alliance for Improved Nutrition

MAPPING OF INDUSTRIALLY-PRODUCED TRANS-FAT (iTFA) IN NIGERIA

A report on sources and replacement solutions for iTFA in Nigeria

March 2020

Contents

The report was made by an independent consultant, Olufolakemi Mercy Anjorin, to support a pilot project on the removal of industrially produced trans-fatty acids (iTFA) in Nigeria and subsequently reviewed and edited by the Global Alliance for Improved Nutrition/SUN Business Network. Olufolakemi Mercy Anjorin gratefully acknowledges the oversight and guidance provided by Professor Fapojuwo. The research assistance and the transcription services provided by Ebunoluwa Odeyinde is acknowledged.

Box 1: GAIN/SBN Pilot Project on iTFA replacement. A business to business (B2B) initiative

The Global Alliance for Improved Nutrition/Scaling Up Nutrition Business Network is conducting a pilot project with the International Food and Beverage Alliance to support the replacement of iTFA by local companies in Nigeria and Pakistan. The project includes: a mapping exercise of the context of iTFA consumption and potential replacement solutions in the country (through desk research and interviews), conducting a workshop on iTFA replacement solutions with experts from IFBA and a follow up with selected companies to support them in implementing iTFA replacement solutions. A final report will summarise outcomes of the pilot project around March 2020.

Box 2: Methodology for this report

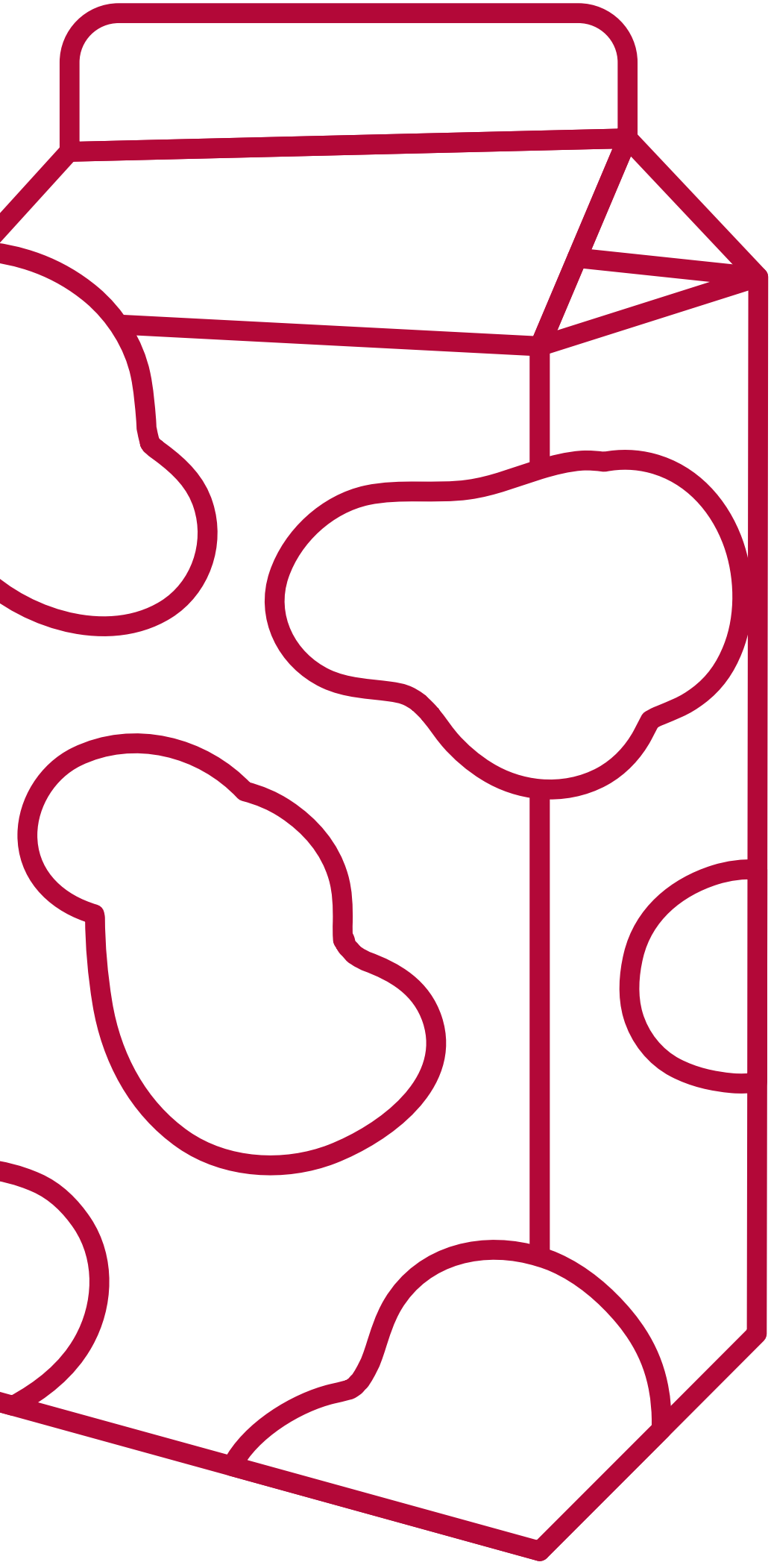
The study was conducted in eleven states across five geopolitical zones in Nigeria. A qualitative approach was used for data collection and analyses. Methods used for data collection include literature review and key informant interviews using pretested interview guide which assessed the raw materials used, processing methods and other manufacturing conditions for food products known to contain iTFA. Thirty-one key informant interviews were conducted among SME players (23) and experts (8) promoting the enabling environment for iTFA reduction in Nigeria. The report is organised into five sections:

- Background
- Methods for mapping of possible sources of iTFA in Nigeria
- Results
- Replacement options of iTFA
- Conclusion and recommendations

The content of the workshop discussions held on 29 October 2019 in Lagos, Nigeria was also used for this report. The workshop gathered more than forty participants from the private and public sector.

Acronyms list

AOAC	Association of Official Agricultural Chemists
CPO	Crude Palm Oil
CVD	Cardiovascular Disease
DFA	Distilled Fatty Acids
HDL	High-density Lipoprotein
iTFA	Industrially Produced Trans Fatty Acids
KPO	Kernel Palm Oil
LDL	Low-density Lipoprotein
MSME	Micro, Small and Medium Enterprise
NADFAC	National Agency for Food and Drug Administration and Control (Nigeria)
NFH	Nigerian Heart Foundation
NSN	Nutrition Society of Nigeria
PHO	Partially Hydrogenated Oil
PHVO	Partially Hydrogenated Vegetable Oil
PUFA	Polyunsaturated Fatty Acid
RDB	Redefined Bleached Deodorised
SME	Small and Medium Enterprise
SOP	Standard Operating Procedure
TFA	Trans Fatty Acids
WHO	World Health Organisation



Executive summary

Trans fatty acids (TFAs) are unsaturated fats found in foods obtained from ruminants, such as dairy products and meat, and in industrially produced partially hydrogenated vegetable oils (PHVO) - the main sources of industrial trans-fatty acids (iTFA). The main risks associated with iTFA consumption are heart attacks and death from heart diseases. Options to replace iTFA with healthier oils and fats exist and can be implemented. In May 2018, the World Health Organisation (WHO) launched the REPLACE action package to support governments to eliminate iTFA from the global food supply by 2023.[1]

While significant and rapid progress has been achieved in high income countries, many low- and middle-income countries have not started the replacement of iTFA within their markets. This report reviews the context of iTFA consumption in Nigeria and assesses possibilities and challenges around iTFA replacement in the food value chain.

The level of awareness about iTFA is low among most of the stakeholders interviewed and regulations are yet to be implemented. However, some progress is being made. The federal government of Nigeria through the National Agency for Food and Drug Administration and Control (NAFDAC) is currently revising the Fats and Oil Regulations 2019, which will set allowable limits of TFA in oils and fats manufactured in or imported into Nigeria. Nigeria has already established an intersectoral working group to address TFA elimination and many stakeholders are actively engaging with a Trans-Fatty Acid (TFA) Technical Working Group.

The report looks at sources of iTFA in the food value chain especially in products with estimated high iTFA content such as biscuits, fried foods (French fries, pizza, puff puff), deep-fried fast food (akara, fried chicken), plantain chips, crackers, sauces and seasonings, ice cream, doughnuts, pastries, cakes. Based on the interviews conducted, biscuits and imported margarine may be among the primary sources of iTFA in Nigeria. Secondary sources might include baked products such as bread, cakes and other confectionery. Our literature review suggests that fat is used in biscuit manufacturing and the ways in which iTFA is introduced in the Nigerian food chain is through the deodorisation of crude oil (which is relatively high at an average temperature of 270 to 280°C for crude palm oil) and through margarine. According to most bakers interviewed, commonly used margarines in the baking industries are not locally manufactured but imported from countries such as the Netherlands and Malaysia.

The stakeholders interviewed for this report unanimously agreed that assessing the current levels of iTFA in the food supply in Nigeria should be a priority. However, the lack of a reference in-country laboratory with the requisite capacity (in both equipment and analytical methodology) to effectively conduct testing of iTFA in food samples in Nigeria is a huge gap to achieve this objective.

In the Nigerian context, fractionation and blending seem the most feasible iTFA replacement option at the moment. The simplicity of fractionation technology, availability of raw materials such as crude palm oil makes this option feasible for local companies including Small and Medium Enterprises (SMEs) in Nigeria. Palm oil can be subject to processing to obtain different fractions of oil (olein and stearin) that have the required characteristics such as a high melting point that is useful in food processing. One key challenge around iTFA replacement in Nigeria is balancing cost implications of the replacement options with the overall health impact and the need to limit the content of saturated fat in the reformulated products.

This study highlights the challenges and opportunities that the Nigerian private sector faces in understanding and replacing iTFA. While fractionation and blending appear as the most feasible iTFA replacement solutions for Nigerian companies, they will need a better enabling environment to successfully tackle this issue. Adequate laboratory capacities and regulations are needed in the country to achieve global iTFA replacement by 2023 in accordance with WHO recommendations.

1 https://www.who.int/nutrition/topics/replace-transfat

Introduction

Trans-fatty acids (TFAs) are unsaturated fats found in industrially produced partially hydrogenated vegetable oils (PHVO also known as iTFA) as well as in foods obtained from ruminants, such as dairy products and meat. Consumption of industrially produced trans fatty acid (iTFA) is associated with an increased risk of cardiovascular disease[2]. iTFA produced by PHVO are not found naturally in foods and do not have known health benefits. iTFA was introduced in the 1980s to address concerns about the health impact of the consumption of fats from animal origins. It also brought other benefits to the food industry such as an increase of products' shelf life and lower refrigeration requirements for storage. The need to considerably reduce or practically eliminate iTFA from the food supply is broadly recognised as a public health goal. Removing iTFA is one of the priority targets of the World Health Organisation (WHO) strategic plan (13th General Programme of Work -2019-2023). Replacing iTFA in the human food supply is feasible with the participation of food services food services, food and cooking fat manufacturers and restaurants. In Nigeria, there is limited knowledge about the application of iTFA among local and national food manufacturers. Currently, there is limited knowledge in Nigeria on how to eliminate iTFA and on iTFA use among local and national food manufacturers.

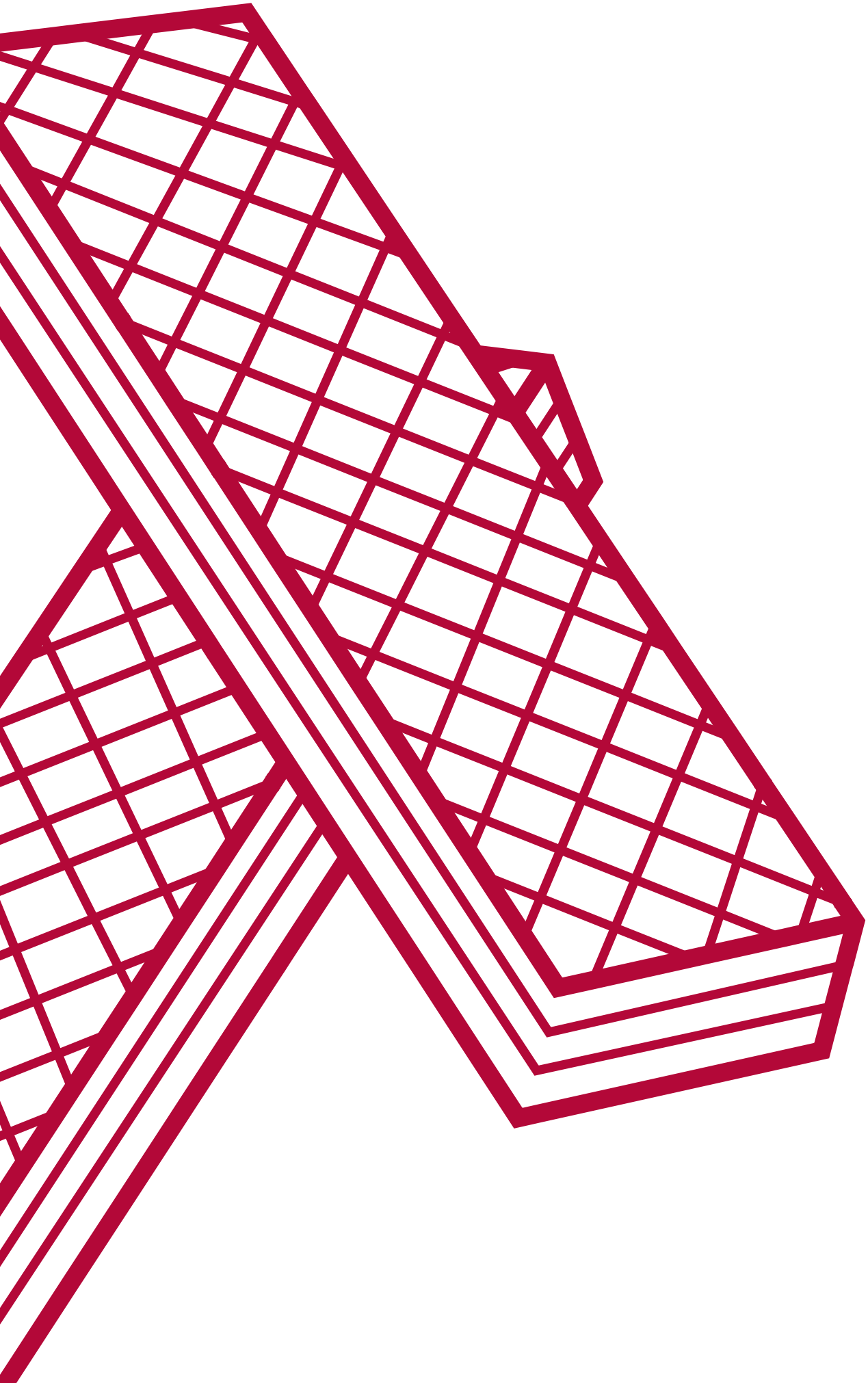
In 2018, the WHO launched the REPLACE action package, a step-by-step guide for the elimination of iTFA from the global food supply chain. The REPLACE action package is comprised of six strategic action areas to ensure the prompt, complete and sustained removal of iTFA. These action areas include: reviewing dietary sources of iTFA and the landscape for necessary policy change, promoting the replacement of iTFA with healthier fats and oils, legislating or enacting regulatory actions to eliminate iTFA, and other measures.

In Nigeria, assessments of iTFA are rare, and there is a dearth of information on available policies on the elimination of iTFA. There is a need to understand the regulatory requirements for trans fat labelling in Nigeria. It is also vital to assess regulatory efforts to reduce the content of iTFA in the food supply. The National Agency for Food and Drug Administration and Control (NAFDAC) recently released a draft Fats and Oil Regulations 2019.[3] Partners have been invited to provide comments to the document during the first quarter of 2020, the document which will be finalised in 2020 will replace the previous 2015 Fats and Oil Regulations.

2 Mozaffarian, Katan, Ascherio, Stampfer, & Willett, 2006; Teegala, Willett, & Mozaffarian, 2009

3 National Agency for Food and Drug Administration and Control, Fats and oils regulations 2019 https://extranet.who.int/nutrition/gina/sites/default/files/NGA%202019%20Fats-and-Oils-Regulations.pdf

1



1. Background

1.1 Overview of sources of trans fat in the food supply

Fats and Oil: Fats and oils are the most abundant lipids in nature and are composed of molecules known as triglycerides, which are made of three fatty acid units linked to a glycerol. Fats contain long hydrocarbon chains which can either be saturated or unsaturated. Unsaturated bonds are also called double bonds, and form when adjacent carbon atoms bond twice with each other rather than with a hydrogen atom. Fatty acids with no double bonds are "saturated" with hydrogen and therefore called saturated fatty acids (SFA). Fatty acids with one double bond are referred to as mono-unsaturated fatty acids (MUFA) while those with several double bonds are called poly-unsaturated fatty acids (PUFA). There are several fatty acids found in food, and it includes palmitic, and stearic (which are both saturated), oleic (monounsaturated with 1 *cis* double bond), linoleic (polyunsaturated with 2 *cis* double bonds), and linolenic acids (polyunsaturated with 3 *cis* double bonds)[4].

There are certain rules of thumb for how fatty acid composition affects the properties of oils and fats and the rules involved are:

- Longer fatty acids (bigger fat molecules) have higher melting temperatures.
- Straight fatty acids can pack closely together in crystals and have a higher melting point.

'Kinked' fatty acids (rather than straight) cannot pack well. Fatty acids can have 0-3 kinks, called cis unsaturated bonds. Higher numbers lead to lower melting points. Oxygen reacts easily with unsaturated bonds. More unsaturated bonds mean potential of more oxidation which degrades the quality of an oil and eventually produces rancidity in oil.

1.1.1 The origin or sources of Trans fatty acids (TFAs) in food supply.

Trans fats are unsaturated fatty acids which have at least one double bond in the trans configuration[5] (Figure 1). There are two broad types of trans fats found in foods:

- Naturally occurring trans fats which are found in meats and dairy products at relatively low levels[6]. Naturally occurring trans fats are produced by the action of bacteria in the stomach of ruminants such as cows, sheep and other ruminants[7]. Gastric bacteria isomerases convert the cis double bonds of unsaturated fats to a trans position[8]. Naturally occurring trans fats are often consumed in smaller amounts.[9]
- The majority of iTFA occur as the result of an industrial process that adds hydrogen to liquid vegetable oils to make them solid fats. The primary source of artificial trans fat is processed foods containing "partially hydrogenated oils" (PHOs)[10].
    - The term industrially produced trans-fatty acids (iTFA) refers to TFAs introduced as a result of food processing, including partial hydrogenation of vegetable oils, refining, frying and heating oils.
    - PHVOs are the product of catalytic hydrogenation of vegetable oils. Partial hydrogenation of the unsaturated fat converts many of the cis double bonds into trans double bonds by an isomerization reaction

4 Eckel, Borra, Lichtenstein, & Yin-Piazza, 2007
5 Mozaffarian et al., 2006.
6 Eckel et al., 2007
7 Mozaffarian et al., 2006
8 Nishida & Uauy, 2009
9 Mozaffarian et al., 2006
10 Mozaffarian, 2015

(both geometric isomerization and positional isomerization) with the catalyst used for the hydrogenation thereby producing iTFAs. Also, partial hydrogenation converts some of the unsaturated bonds to saturated bonds[11]. PHVOs typically contain over 20 unique TFA isomers of oleic and linoleic acid, which increases the solidity and stability of the fatty acids[12]. The TFA content of PHVOs depends on the variables of the hydrogenation process which include time, catalyst, temperature and hydrogen pressure. Other variables include the types and proportions of oils and composition of MUFA and PUFA[13].

- Light processing (brush hydrogenation) is adopted in the processing of oil to produce liquid oil with greater shelf-life. The process lessens double bonds in α-linolenic acid, thereby reducing oxidative tendencies of the oil[14].

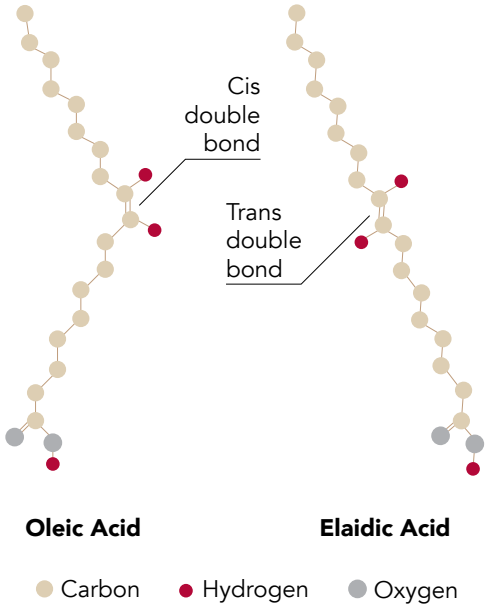


Figure 1: Structure of Cis and Trans Fatty Acids. Mozaffarian et al., 2006

In 2010 an estimated 1,300 Nigerians were reported to have died as a result of high TFA intake.

1.1.2 Health consequences of Trans fats in Nigeria

There are limited data on the burden of TFA in Nigeria. The risks associated with iTFA consumption are, however, largely known and recognised. In 2010, an estimated 1300 Nigerians were reported to have died as a result of high TFA intake, and mean TFA intake was 0.9% of total energy intake[15]. The negative effects of TFA on the health of humans far outweigh the benefit it offers in terms of increasing the shelf life of processed foods and other associated sensory properties. Evidence exists that TFA raises low density lipoproteins (LDL), triglycerides and insulin levels and reduces high density lipoprotein (HDL).[16] TFA from PHVOs are known for their independent

11 Nishida & Uauy, 2009
12 Nishida & Uauy, 2009
13 Dhaka, Gulia, Ahlawat, & Khatkar, 2011
14 Nishida & Uauy, 2009
15 Wang, Gravelle, Blake, & Marangoni, 2016
16 J Am Heart Assoc. 2016 Jan 20;5(1). pii: e002891. doi: 10.1161/JAHA.115.002891.

associations with cardiovascular events.[17] Intake of TFA at high levels (2.5 to 6.3% of total energy) is associated with an increase in the relative risk of CVD death by over 30% and CVD events by 25% when compared to low (< 1-2.4% total energy) intake of TFA.[18]

The burden of non-communicable disease in Nigeria is huge; a focus on identifying and reducing dietary risks (including TFA) should be a priority. In Nigeria, in 2016 NCDs were estimated to account for more than a quarter (29%) of all deaths annually. CVDs, cancers, diabetes accounted for 11%, 4% and 1% of mortality respectively. Total NCD deaths in Nigeria in 2016 was 617,300 with more deaths occurring among women (323,600) compared to men.

1.1.3 Sources and use of iTFA among local and national food manufacturers in Nigeria

iTFA can be found in hardened vegetable fats, which include margarine and ghee, or in snack food, baked foods, and fried foods. Most manufacturers choose oils that contain iTFA due to factors such as longer shelf life than other, fats, cost, and the ability to withstand repeated heating, often semisolid at room temperature and therefore suitable for use in baked products.[19]

While the global momentum to reduce and possibly eliminate iTFA in processed foods is growing, information about iTFA sources and replacement is rare in Nigeria. Inexpensive PHO has become a staple not only for the food industry but also for home use. Nigeria's market for PHO is the largest in Africa, with an estimated market volume of 229 000 tonnes in 2017. This estimate represents approximately 8.5% of Africa's total PHO market volume[20].

There is a limited account of the major sources of TFA in the food supply or the population intake in Nigeria, this is due to the lack of established monitoring system for TFA. Local and national food manufacturers use iTFA for the following (based mostly on information from WHO Replace action package, module 'Promote'):

Frying and Grilling. Frying and grilling require oxidative stability, especially if fats are used at higher temperatures for a prolonged time (for example, in deep-frying). Solid fats are chosen for frying and grilling mainly for oxidative stability. For deep-frying of doughnuts, for instance, solid fat is needed to give a glazed aspect and prevent migration of liquid oil into coatings and packages. For grilling and shallow-frying, and as a pan release agent, liquids are sprayed on, and viscous liquids are brushed on. Oils for commercial frying may be a source of iTFA since commercial applications such as deep-fried foods, and packaged snack chips require stability related to the thermal deterioration processes of oxidation, hydrolysis and polymerization. Therefore, stable frying oils have an increased amount of oleic acids and a decrease in the amount of linoleic acid.[21] Fried and grilled products commonly consumed in Nigeria are doughnuts, chin-chin, plantain chips (often unripe plantain), and fried ripe plantain, fried bean cake (Akara), fried fish, yam, potatoes, amongst many others (Table 1).

One study suggests that cooking oils commonly used for domestic purposes in home cooking may not contain iTFA and cooking this type of oil in domestic kitchens may not produce iTFA[22]. Other studies have shown that fats/ oils subjected to high temperature heating/ re-heating show high levels of TFA and SFA.[23] The heating temperature of vegetable oils should be kept under 150°C, to avoid the risk of iTFA formation.[24] Stir-frying at a temperature of 170°C increases the iTFA content when

17 Lamarche & Couture, 2015; Micha & Mozaffarian, 2009; Skeaff & Miller, 2009.
18 Skeaff & Miller, 2009
19 Mozaffarian & Stampfer, 2010
20 Persistence Market Research, 2018 in WHO, 2019
21 Eckel et al., 2007
22 Eckel et al., 2007
23 Bhardwaj et al., 2016
24 Li et al. 2013

compared to raw oil before cooking.[25] Other studies suggest that a mechanism different from those of hydrogenation and biohydrogenation causes trans isomerization during heating.[26]

Margarine and spreads. Margarine is produced as an alternative to butter at 80% fat. Products with other fat levels are generally called spreads. Consumers often use a single product for spreading on bread, cooking and baking. Different baking applications involve the use of industrial margarine. Both butter and spreads are emulsions in which a matrix of solid fat crystals binds liquid oil and small droplets of water that hold flavour compounds. Solid fat ("hardstock") is needed to make spreads. By selecting hardstocks and processing conditions, spreads can be designed to be softer or harder at refrigerator and room temperature and to be lower or higher in total iTFA and SFA.

Baking. Semi-solid fats are often used in baked goods because they enable easy mixing and give pliability to the dough. Specific solid fat crystals give flakiness, hardness, volume increase, layer separation and air entrapment to baked foods. Coatings for baking goods need to be hard at room temperature and have a steep melting curve at 30-35°C in order to melt in the mouth. For icings and creams, semi-solid fats are selected to give enough fat crystals for aeration, they are soft at both lower and higher temperatures (a flat melting curve), and do not leave a waxy mouth feel (few solids above 40°C).

Table 1: Likely sources of iTFA in Nigeria

Fast food/ Restaurants and Eatery products	Supermarket products	Fats and oils	Bakery products
▪ Fried foods (French fries, pizza, puff puff) ▪ Deep-fried fast food (akara, fried chicken) ▪ Plantain chips ▪ Cheese ball ▪ Sausage rolls	▪ Ready-to-microwave popcorn ▪ Wafers ▪ Crackers ▪ Noodles ▪ Sauces and seasonings ▪ Ice cream	▪ Shortenings ▪ Partially hydrogenated oils ▪ Some margarines	▪ Doughnuts ▪ Biscuits ▪ Cookies ▪ Pastries ▪ Cakes

25 Malczewski, 2017
26 Gotoh et al., 2018

1.2 iTFA consumption in Nigeria, market size for food products with possible iTFA content in Nigeria

Estimating iTFA consumption in Nigeria remains challenging in the absence of national food consumption data. For this study, the market size of the food products with possible iTFA content was reviewed to present an understanding of food products that may constitute more likelihood of risk to population groups if found to include TFA. The following section summarises the market size for the products that are likely to contain TFA in Nigeria.

Biscuits (sweet biscuits). The sale of sweet biscuits was between 94,700 tonnes to 116,900 tonnes over the period 2012 to 2017 respectively (Table 2). The estimated sales value of sweet biscuits in Nigeria in the year 2016 was NGN98 billion representing a slight decrease in value from the NGN101.6 in the year 2015 (Table 3). Yale Foods Nigeria remained the leading player of biscuits companies in Nigeria in the year 2017 with a 35% share of retail value sales while Pladis Nigeria (formerly A & P Biscuits) continues to gain retail value Share (Figure 2).

Table 2: Sale of sweet biscuits: Volume 2012-2017.

'000 tonnes	2012	2013	2014	2015	2016
Chocolate coated biscuits	0.8	0.9	1.0	1.0	0.8
Cookies	7.5	8.2	9.0	9.6	7.6
Filled Biscuits	17.6	19.1	20.6	21.0	16.7
Plain Biscuits	64.0	68.7	74.9	78.0	63.9
Wafers	5.9	6.3	6.9	7.2	5.8
Sweet Biscuits	**95.8**	**103.2**	**112.4**	**116.9**	**94.7**

Source: Euromonitor report July 2017

Table 3: Sale of sweet biscuits: Value 2012-2017.

NGN billion	2012	2013	2014	2015	2016
Chocolate coated biscuits	1.2	1.4	1.6	1.8	1.7
Cookies	7.7	9.1	10.7	12.2	11.7
Filled Biscuits	11.7	14.0	15.9	17.9	17.1
Plain Biscuits	39.7	46.0	53.4	61.6	59.8
Wafers	5.3	6.1	7.0	8.1	7.7
Sweet Biscuits	**65.6**	**76.4**	**88.6**	**101.6**	**98.0**

Source: Euromonitor report July 2017

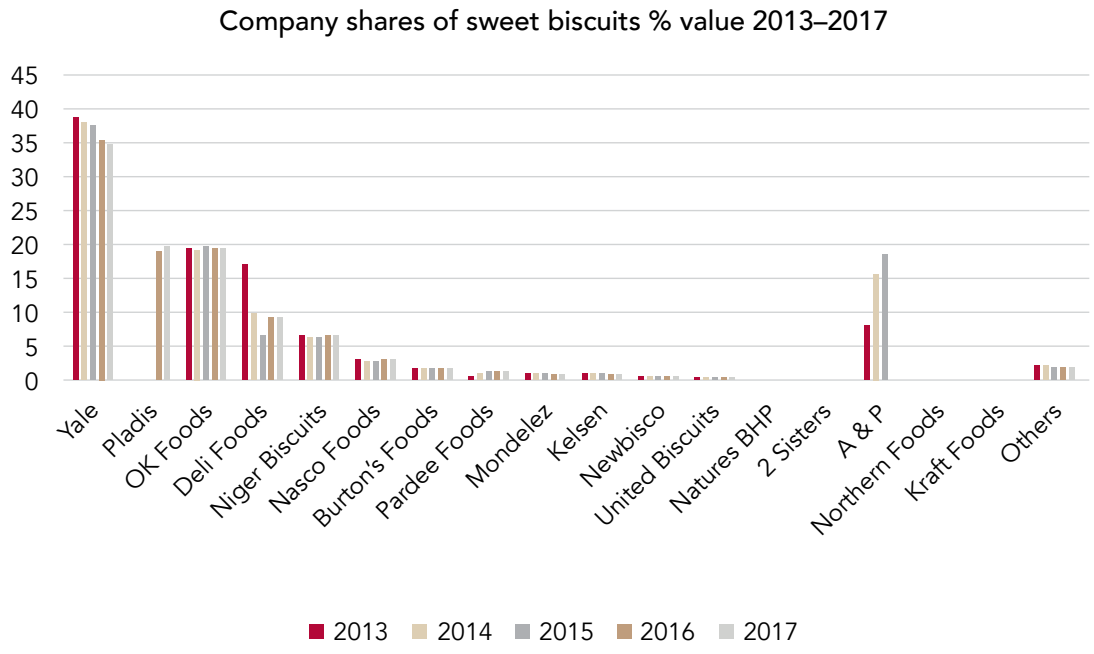


Figure 2: Company share of sweet biscuits in Nigeria.

Source: Euromonitor International, 2017

Noodles. In Nigeria, instant noodles are fast gaining popularity as the most important staple, and noodles performed better than rice and pasta in the year 2017.[27] Convenience, cost and wide availability contribute to the choice of noodles in Nigeria. Dufil Prima Foods PLC, the producer of the Indomie noodles brand led rice pasta and noodles market in Nigeria in 2017[28] and 2018.[29] According to a CNN report in January 2019, Nigeria has become the 12th largest instant noodle market in the world with local consumption of 1.76 billion servings of noodles annually.[30]

Nigeria Edible Oils Market. Nigeria edible oils market is comprised of unpackaged bulk oil and packaged edible oils. In Nigeria, there is a huge demand for edible oils given the population size and preference for fried food products such as fried meat, fried bean cake (Akara), and fried yam/potato. However, the consumption of edible oil in Nigeria has historically been dominated by unpackaged oils, which are cheaper than packaged and branded products. Intense competition between brand manufacturers drives the growth in the edible oil market in Nigeria.[31]

In 2018 the average unit price of edible oils fell. Manufacturers sought to drive demand and turned to locally available raw materials since depreciation in local currency made imports more expensive.

Consumers tend to be more familiar with edible oils which comprise groundnut oil, or vegetable oil made from palm olein (the liquid component of palm oil). PZ Wilmar's Devon King's brand remained the leading brand in 2018. Strong distribution accounts for the success achieved for King's oil brand. Dufil Prima Foods, also performed well over 2016-2018, largely due to making more widely available its affordable "pillow pack" (flexible sachet) variant. The flexible sachet has enabled Dufil to capture consumers who are used to cheap unpackaged oil.

Apart from product price differentiation and product repackaging, manufacturers of edible oils (especially those of leading and fastest-growing brands such as power oil, Mamador and Devon King's oil) in Nigeria use health-based campaigns to compete and gain market share. Brands are often marketed as "zero cholesterol", "zero trans-fat" and "vitamin enriched", for example containing added vitamins A and E. Endorsement and product fortification are other promotional drives embarked on by manufacturers to enhance patronage and acceptance. Endorsements of products around their "heart friendliness" by organisations such as the Nigerian Heart Foundation and the Nutritional Society of Nigeria is used as a marketing tool to increase sales by some edible oil producers[32].

Other brands competing for the market share of edible oil in Nigeria include Sunola Oil, manufactured by Sunseed Nigeria Limited; Grand Oil, produced by Grand Cereal and Oil Limited; Famili Pure Vegetable Oil, Lesieur Pure Vegetable Oil as well as other imported edible oil brands, such as Wesson Canola.

27 Euromonitor International, 2017

28 Euromonitor International, 2017

29 https://www.euromonitor.com/rice-pasta-and-noodles-in-nigeria/report

30 https://instantnoodles.org/en/noodles/market.html

31 Edible Oils in Nigeria, EuroMonitor International report November 2018 https://www.euromonitor.com/edible-oils-in-nigeria/report

32 Nigeria: Edible Oil Producers Compete With Endorsement, Product Fortification Vanguard, 1 May 2018 https://allafrica.com/stories/201805010204.html

Box 1: Vegetable oil brands identified in Lagos Metropolis. Okpuzor et al, 2009.

- Sesame
- Century
- Sunola (grdnut)
- Kings
- Grand (soya)
- Laser
- Golden cup
- Turkey
- Lesieur
- Olive
- Oki
- Grand (grdnut)
- Harvop
- Bimoli
- Sania
- Savoil
- Famili
- Gino
- Zok
- Coconut
- Palm oil

PHO Market in Nigeria. Nigeria's market for PHO is the biggest in Africa, with an estimated market volume of 229 000 tonnes in 2017 (roughly 8.5% of Africa's total PHO market volume).[33] The estimated PHO market volume of 229 000 tonnes for Nigeria comprises domestic production of palm oil (133 000 tonnes), groundnut oil (43 000 tonnes) and soybean oil (21 000 tonnes), along with palm oil imports (32 000 tonnes).[34] Unpackaged oil accounts for a significant share of Nigeria's domestic edible oil consumption compared with packaged and branded products.[35]

Margarine, spread and butter. Nigerians widely consume margarine and spreads, whereas butter remains a niche product largely consumed by expatriates and upper-income consumers. Unilever Nigeria Plc led retail value sales in Nigeria in 2018 with a fairly dominant share. Its Blue Band brand has historically enjoyed a near-monopoly in Nigeria, and so it has gained strong brand equity. Rasco & Brothers Nigeria Ltd saw the strongest increase in share in 2017 and 2018, having launched only in 2015. A range of smaller pack sizes for its True Vine margarine brand has helped it appeal to lower-income consumers, due to greater affordability.[36]

Plantain chips. Processed fruit snacks such as plantain chips are widely available in Nigeria and perceived as a cheap, filling, sweet and healthy snack that suits on-the-go consumers.[37] A study conducted in states located in the South West Geopolitical Zones of Nigeria suggests that over half (52%) of plantain chips processors sell their plantain chips directly to individual buyers.[38] Most are likely to be microprocessors since the same report estimated that the net annual income of plantain chips processors was ₦113,600. Most city dwellers in South West Nigeria consume plantain in the form of ripe fried plantain (Dodo), plantain chips and plantain flour compared with their rural counterparts who consume cooked plantain and roasted plantain.

Potato chips were found to be the weakest performer in 2017 as a result of the depreciation of the local currency, considering that products in the category are mostly imported, the unit price skyrocketed and became unaffordable.

Other likely sources of TFA in Nigeria include cakes, pies, cream-filled candies, doughnuts, and deep-fried foods and edible oils. Table 4 below provides information on the sale of packaged foods with likely TFA.

33 Persistence Market Research, 2018
34 Persistence Market Research, 2018
35 Persistence Market Research, 2018
36 Butter and spreads in Nigeria-Sept 2018 https://www.euromonitor.com/butter-and-spreads-in-nigeria/report
37 Euromonitor International, 2017
38 Ayanwale, Fatunbi, & Ojo, 2018.

Table 4: Sales of packaged food: Volume 2012-2017.

'000 tonnes	2012	2013	2014	2015	2016
Baked Goods	57.6	59.9	62.3	64.7	61.5
Breakfast Cereals	0.5	0.6	0.6	0.6	0.5
Confectionery	0.5	0.5	0.5	0.5	0.3
Dairy	18.3	18.9	19.5	20.1	13.4
Edible oils	34.4	35.4	36.6	37.7	35.0
Ice cream and Frozen Desserts	0.3	0.3	0.3	0.3	0.2
Sauces, Dressings, Condiments	100.8	105.0	109.4	113.3	109.6
Rice, Pasta and Noodles	93.8	97.7	101.9	105.6	106.1

Source: Euromonitor report July 2017[39]

39 Euromonitor International, 2017

1.3 iTFA regulation in Nigeria

There are several policies and measures aimed at reducing iTFA in food. These measures include voluntary self-regulation by food manufacturers/processors, labelling regulations, and national bans. Some countries implement a combination of these measures. A systematic review of evidence found that policies aimed at restricting the iTFA content of food were associated with significant reductions in iTFA levels without increasing total fat content.[40] National and local bans were reported to be the most effective actions for eliminating iTFA from the food supply. Other regulations, such as mandatory iTFA labelling and voluntary iTFA limits, had a varying degree of success.[41] Additionally, labelling requirements often apply to packaged foods, therefore in Nigeria where the majority of the population may purchase unpackaged products, the impact of labelling may be limited.[42] The Codex Committee on Food Labelling at the 31st Session in May 2003 decided that the declaration of TFA in the labelling should be left to national legislation.[43]

The WHO global framework for monitoring NCDs includes indicators and targets for monitoring NCDs. One of these indicators is the adoption of national policies that eliminate PHVO in the food supply and replaces PHVO with PUFA. While the elimination of iTFA from the food supply has been considered feasible, there are challenges and some resistance to change notably in emerging markets.[44]

WHO, in a report released in May 2019, indicated that in Nigeria, no regulations exist on the use of PHO or the amount of iTFA in food. NAFDAC has authority to issue or amend regulations that ban or regulate the levels of components in food and that NAFDAC may require further legislative authority to prosecute noncompliance with these regulations.

As a first step towards eliminating iTFA in Nigeria, NAFDAC reviewed the 2005 Fats and Oils Regulations. The revised Fats and Oils Regulations are expected to be available in 2020 and to include the labelling of fats and oils and labelling of iTFA (Box 2). The scope of the regulations comprises all foods containing fats and oils manufactured, exported, imported, advertised, sold, distributed and used in Nigeria. A complementary regulation - The Pre-Packaged Food (Labelling) Regulations 2019 also exists. The Fats and Oils Regulations 2019 are currently under revision to include a restriction of the amount of trans fat in foods intended for human consumption to about 2 grams per 100 grams of fat or oil. The documents would benefit from a clear definition of TFA (especially those produced as a result of the industrial process) to ensure that food manufacturers do not face any form of ambiguity in the interpretation of the regulations. The regulations do not explicitly cover consideration for unbranded cooking oils.

A systematic review of evidence found that policies aimed at restricting the iTFA content of food were associated with significant reductions in iTFA levels without increasing total fat content.

40 Downs, Thow, & Leeder, 2013
41 Downs, Thow, & Leeder, 2013
42 Downs et al., 2013
43 Nishida & Uauy, 2009
44 Stuckler, et al., 2012

Box 2: Labelling of Trans Fats (excerpt from working draft of NAFDAC Fats and Oils Regulation, currently under revision for estimated publication in 2020)

"Labelling of Trans Fats

a. The manufacturing and importation of any oils and fats, including emulsions with fat as the continuous phase, either alone or as part of processed foods, which are intended for human consumption or assumed to be intended for human consumption, in the retail trade, catering businesses, restaurants, institutions, bakeries etc., of which the content of Trans-Fat exceeds 2 grams per 100 grams of oil or fat, is prohibited.

b. Where a claim that a foodstuff is "Trans-Fat free" is made on the label or in an advertisement, the content of Trans-Fat shall be less than 1 gram per 100 grams of the total fat or oil in the final product.

c. For a product that contains 2% fat or more, the nutritional label shall indicate the types and levels of each of the fat components in the product: saturated fatty acids, trans fatty acids and cholesterol."

Existing nutrition or food safety policies: the Nigerian National Policy on Food and Nutrition includes strategies for protecting the consumer through improved food quality and safety (strategy 3.3.5). To achieve this objective, the strategy recommends to:

- establish standards for nutrition labelling and the advertisement of all foods, including locally prepared indigenous foods,
- promote compliance and
- strengthen consumer education.

The policy also encompasses strategies for promoting healthy lifestyles and dietary habits (strategy 3.5.2). Approaches to reduce the incidence of NCDs such as diabetes, hypertension, and other cardiovascular disorders are highlighted; specifically, the policy itemised reduction of salt and sugar intake, and preparation methods to reduce fat intake. Similarly, the National Strategic Plan of Action on Nutrition, which is the health sector component of the national nutrition strategy prioritises NCD control however trans fat is not mentioned in this document.

The Federal Ministry of Health of Nigeria in collaboration with the WHO and key stakeholders launched the first Nigerian National Multisectoral Action Plan for the Prevention and Control of NCDs (2019-2025) for Nigeria on 6 August 2019. The multisectoral NCD plan recognises that an unhealthy diet specifically consisting of increased consumption of processed foods high in salt, sugar and trans fats is a behavioural risk factor for CVD, diabetes and cancers. The document, however, did not explicitly include iTFA reduction as part of the specific national targets. However, the priority interventions to promote healthy lifestyle included specific mention of iTFA, as well as plans to adopt standards for front-of-pack labelling. Box 3 and the section that follows summarises the relevant iTFA content of the National NCD strategy.

Box 3: iTFA consideration/priority actions (excerpt from NCD strategy Nigeria 2019-2025, p55-57)

"Consideration:

1.3.4 Replace trans-fats and saturated fats with unsaturated fats through reformulation, labelling using fiscal policies and/or agricultural policies

1.3.6 Implement nutrition education and counselling, mass media and behaviour change campaign on healthy diets including social marketing to reduce the intake of total fat, saturated fats, sugars and salt, and promote the intake of fruits and vegetables."

Consideration:

There is supporting legislation through the NAFDAC Act to support additional/ new regulations on reformulation to reduce salt and replace trans-fats and saturated fats with unsaturated fats in industrially produced foods.

WHO has also developed the REPLACE technical package to guide policy actions aimed at reducing and eliminating industrially produced trans fats. This technical package will also guide the development of reformulation regulations for replacing trans-fats and saturated fats with unsaturated fats"

The implementation plans for the NCDs National Multisectoral Action Plan on NCD include the following iTFA related activities:

- Develop mass media campaign to educate the public on the harms associated with high salt, sugar (sweetened) and iTFA intake. The lead government institution responsible for this activity is the Federal Ministry of Health (Health Promotion). (Activity 5.1).
- Develop a mandatory food reformulation regulation (of industrially processed foods to replace iTFA) under existing NAFDAC act. The lead government agency responsible for this activity is NAFDAC. Sub-activities consist of food analysis to identify the different food sources that contribute to high iTFA intake and convening a consultative forum with the food processing industry to discuss findings of the analysis in order to achieve sanctions and enforcement of a mandatory reformulation regulation. The plan also sets out monitoring evaluation indicators on iTFA.

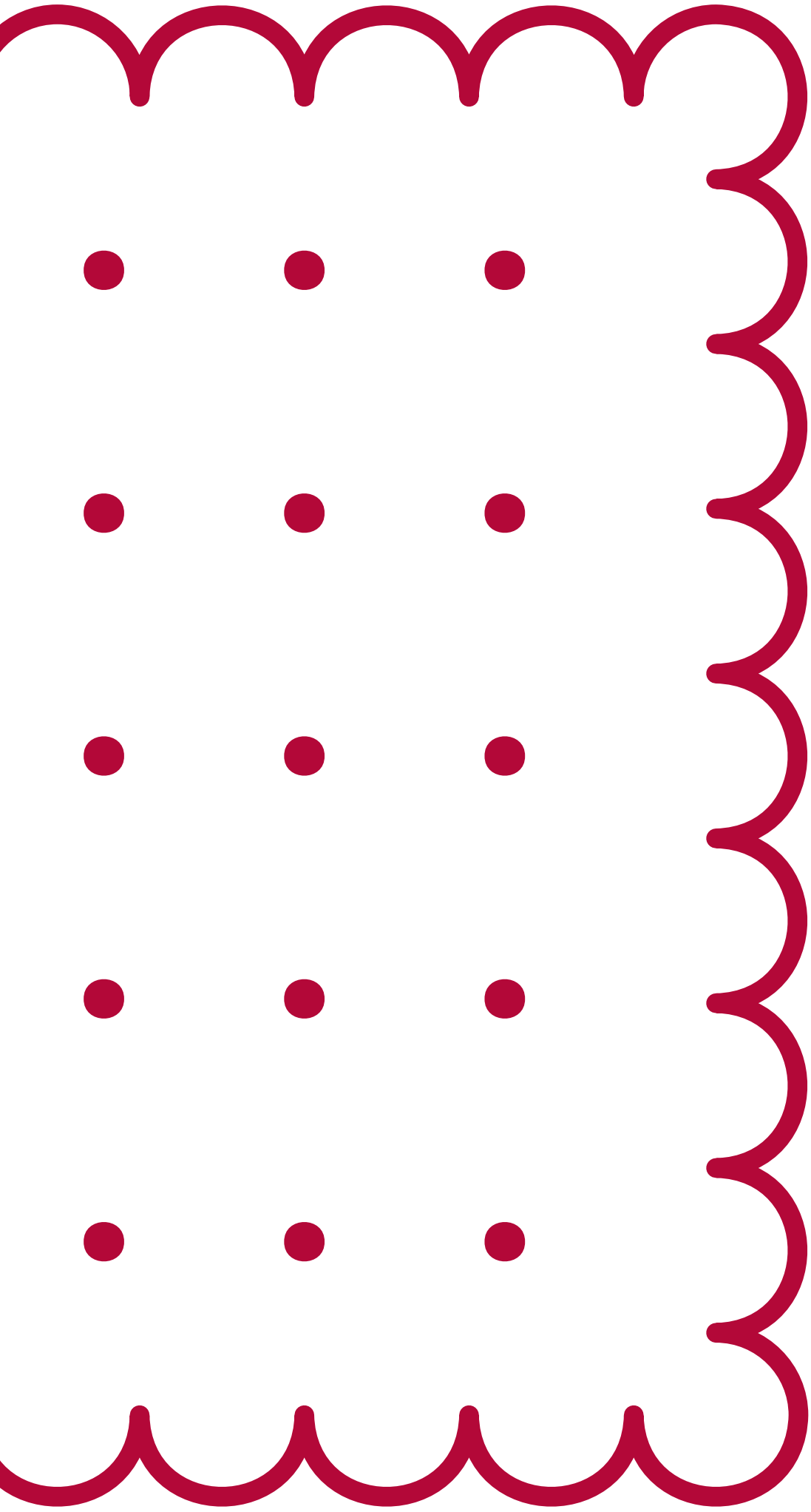
Apart from South Africa which has adopted a best practice TFA policy since 2011, Nigeria is one of the 12 countries in Africa that have a national policy commitment to eliminate TFA.

Existing advocacy efforts to promote awareness on TFA in Nigeria: in 2018, Nigeria established a technical working group (TWG) to address the need to reduce iTFA in the food supply. Also, in 2016, a consensus summit was held on lipid and cardiovascular health in Nigeria population. The summit evaluated information available on the relationship between dietary fat and CVD.[45]

Trans fats levels used as endorsement criteria for selected food products in Nigeria. The Nigerian Heart Foundation heart check food labelling programme is a voluntary food programme developed in 1998 in collaboration with NAFDAC. Interested companies apply to the programme and subject their products to standardised nutrition profile evaluations, which are guided by a set of scientific criteria developed by the Nigerian Heart Foundation and approved by NAFDAC. The set of criteria set out by the Nigerian Heart Foundation heart check food labelling programme includes approved levels of sodium, sugar, cholesterol and trans fat.[46] The Nigerian Heart Foundation grants permission to the applying companies to use the logo on packaged food products that meet the set criteria.

45 Akinroye et al., 2017
46 Akinroye et al., 2017

2



2. Methods for mapping of possible sources of iTFA in Nigeria

WHO provides a set of guidance for the development of a country specific REPLACE roadmap.

In this study, qualitative methods were used to understand the sources of iTFA and existing and ongoing regulatory efforts to address iTFA in Nigeria.

2.1 Methods

This study builds on the WHO REPLACE module 1 (Figure 3) for the assessment of iTFA sources, and replacement options in Nigeria.

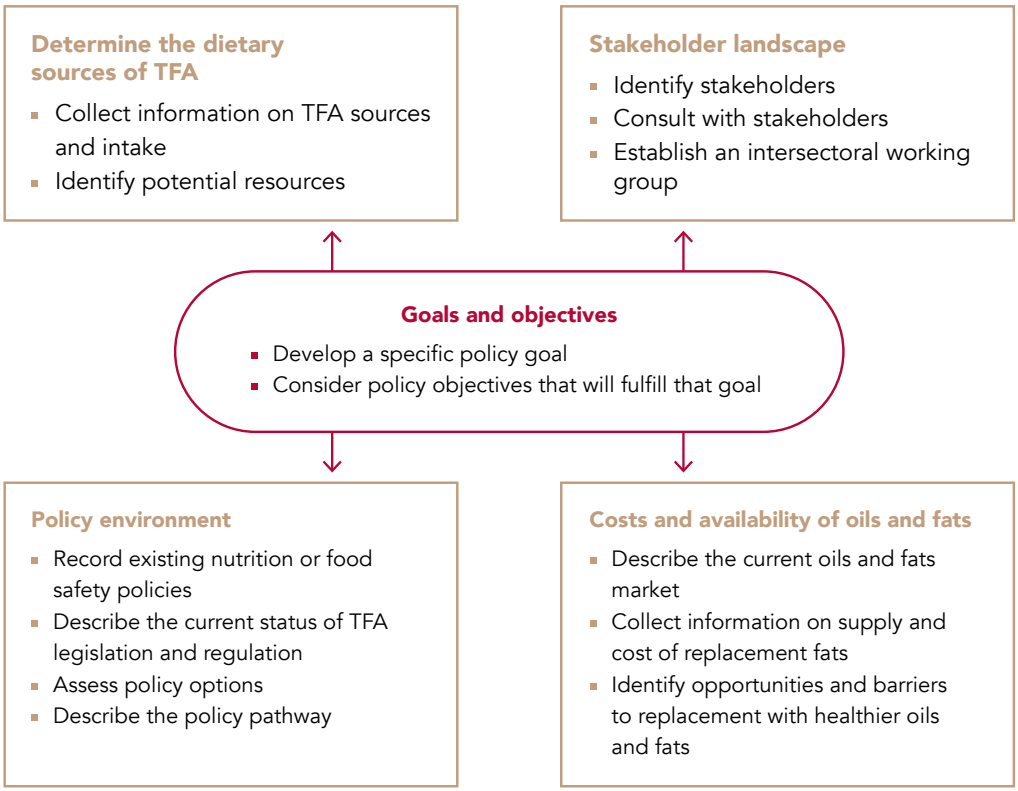


Figure 3: Key Steps to nform a country-specific REPLACE roadmap. WHO REPLACE Action Package, Module 1: Review

- Study design: A cross-sectional qualitative study
- Study population (Annex 1): participants include manufacturers of baked or fried snacks, edible oils, biscuits, mostly Micro, Small and Medium Enterprises (MSMEs) including members of SBN Nigeria. MSMEs were identified through the SBN membership database, internet search, supermarket visits to identify brands, and a snowball sampling technique using selection criteria, which included the manufacturers of products likely to contain iTFA (earlier described in Table 1). Interviewees were those knowledgeable about the production processes of the value chains assessed (e.g. factory/production manager or quality assurance managers). Members of TFA Technical Working Group established in 2018, regulatory officials and private laboratories were also interviewed to understand the enabling environment for iTFA elimination in Nigeria.
- Sampling/sample size: purposive sampling was used to identify stakeholders, and a total of 31 stakeholders participated in the interview for this study. Figure 3 presents the distribution of participants by categories of stakeholders and geo-political zones in Nigeria.
- Data collection: internet search and review of journal articles and grey literature was conducted. Documents related to iTFA global recommendations, dietary sources of iTFA, policy options for iTFA and other relevant documentation (including regulations and guidelines related to iTFA in Nigeria) were reviewed. Also, this study examined preliminary efforts on iTFA advocacy and awareness in Nigeria available in open sources such as online media reports.

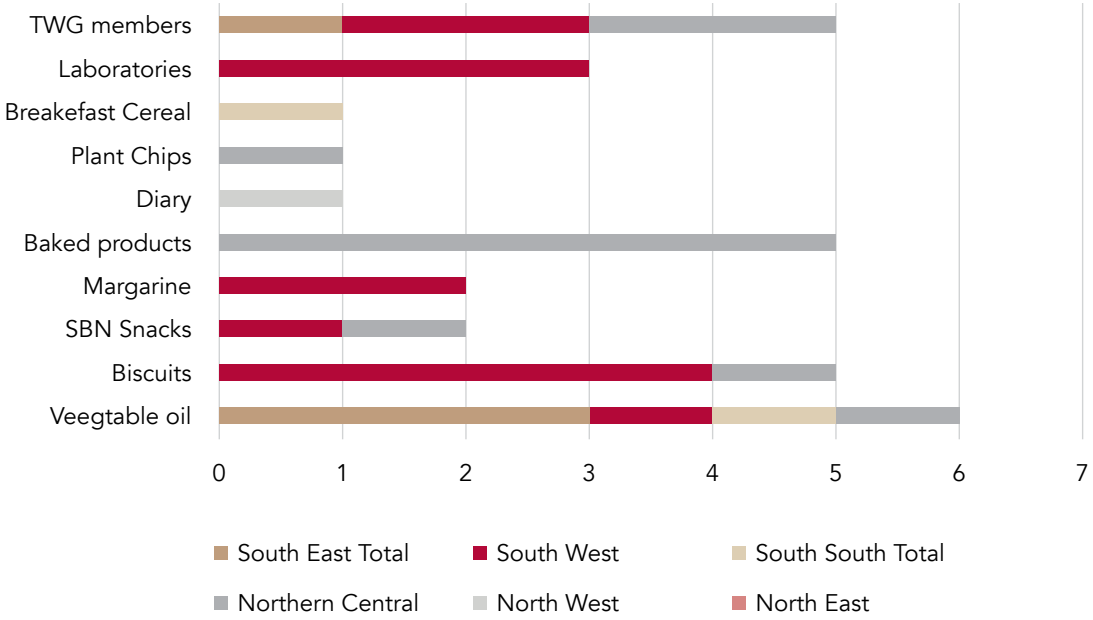


Figure 4: Distribution of study participants by food product and regions

Key informant interviews were conducted. In addition to secondary data, a key informant interview guide was used to elicit information from stakeholders (Annex 2). Information collected includes the knowledge of interviewees about iTFA, processes employed in the manufacturing of products, and the feasibility (technical and financial) of processes that can replace iTFA. Standard operating procedures (SOPs) were reviewed where available or shared. The notes from the observation and the SOPs were used to triangulate information obtained from interviewees. Processing techniques were observed where possible and allowed by the interviewee. Other questions for experts include the policies, regulatory and existing or required capacities to reduce or eliminate iTFA in Nigeria. Current and planned activities related to iTFA elimination in Nigeria were assessed.

All interviews were conducted in English through in-person or telephone interviews with stakeholders. Interviews were audio recorded when allowed by participants. Detailed notes were taken when participants did not consent to an audio recording. Verbal permissions for the study from the relevant administrative heads in each of the respective companies were obtained.

- Study period: data was collected from May 28 to August 2019.
- Data analysis: the recorded key informant interviews were transcribed verbatim and organised using Nvivo 12. The transcripts were analysed to identify key issues relating to iTFA in Nigeria. Open coding was used to guide the coding and analysis of the transcripts. The analysis was done iteratively through reading of the transcripts imported into Nvivo and coding into the codes generated. Transcripts were re-read each time a new code emerged to include components of the new codes that may exist in all the transcripts.

The information regarding the processed raw materials, processing techniques, and the challenges of replacement options for each raw material were obtained directly from the primary data collected through informant interviews and as presented in the results section. However, the assessment of the feasibility of the replacement options for reducing or eliminating iTFA in Nigeria was inferred from the findings of both primary and secondary data (literature review) and presented in the discussion and conclusion section of this report.

Workshop on 29 October 2019. A workshop was organised in Lagos on 29 October 2019, it gathered more than 40 participants from both the public and private sector to discuss iTFA replacement in Nigeria. The meeting focused on incentives and solutions for local companies to engage in iTFA replacement. The content of the presentations shared during the meeting and of the discussions have been used to inform this report.

2.2 Key definitions

- SMEs are broadly defined as businesses with a turnover of less than NGN100 million per annum or less than 300 employees.[47]
- For this study, MSMEs were classified based on the estimated volume of products produced daily. Daily outputs of less than 50 tonnes per day were classified as small, and medium scale companies defined as those having daily outputs between 50 tonnes and 200 tonnes.

Table 5: MSMEs definition by the Bank of Industry Nigeria.48

Enterprise Category	Number of Employees	Total Asset (NGN Million)	Annual Turn Over (NGN Million)	Loan Amount (NGN Million)
Micro	≤ 10	≤ 5	≤ 20	≤ 10
Small	>11 ≤ 50	> 5 ≤ 100	≤ 100	>10 ≤ 100
Medium	> 51 ≤ 200	> 100 ≤ 500	≤ 500	>100 ≤ 500

2.3 Data collection challenges

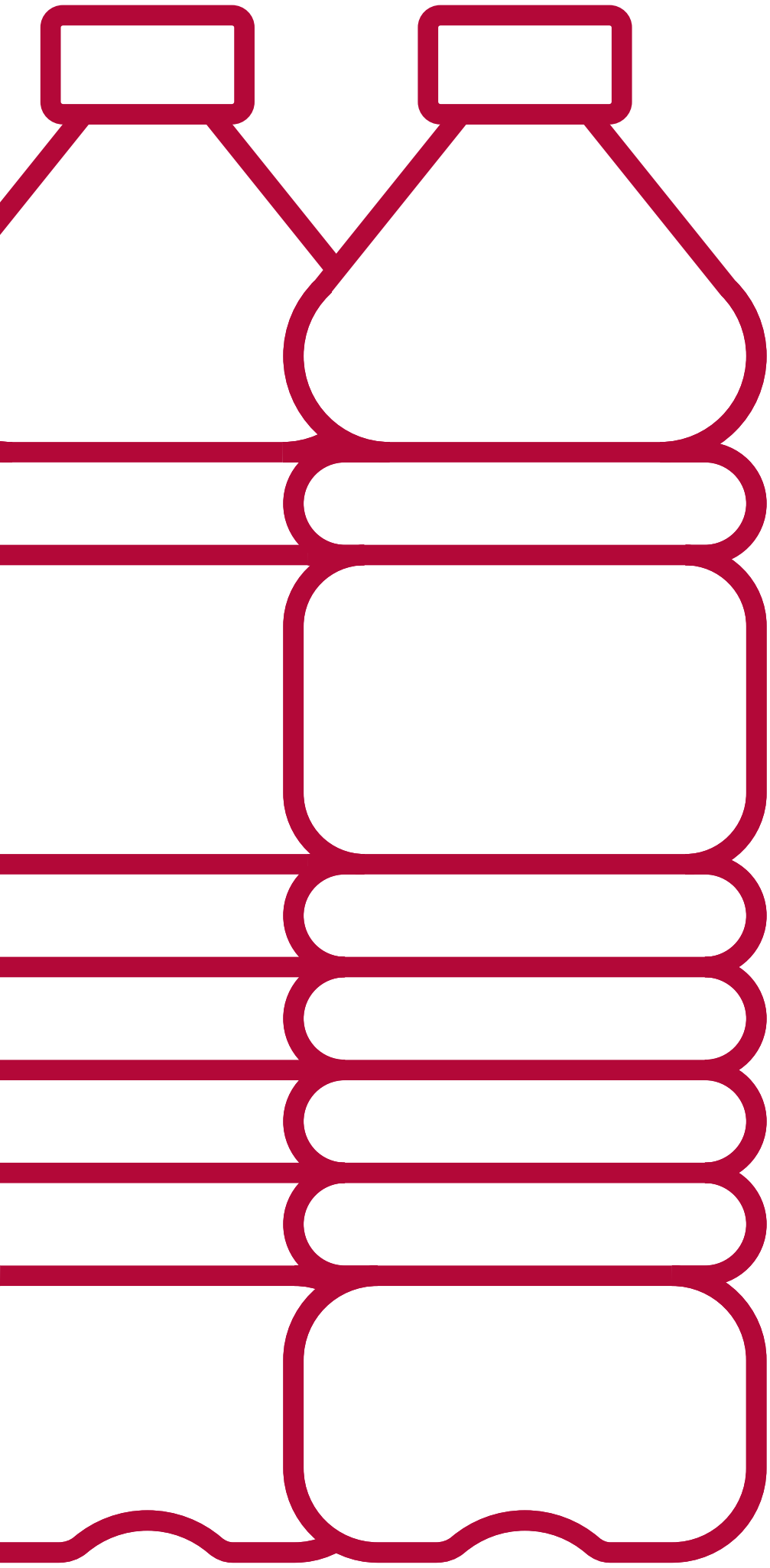
Many companies declined participation in the study. Annex 3 contains the list of companies visited/reached out.

- Most of the big players (mostly medium size organisations) declined participation in the study. Biscuit manufacturers represent the sector that proved the most difficult to penetrate. For instance, only 1 of the 13 biscuit manufacturers contacted granted an interview. Similarly, margarine and noodles companies were reluctant to participate in the study. Contacts of participants in the biscuits and margarine value chain were obtained through informal means to mitigate the limitation of securing interviews. The informal contacts contributed to six additional interviews (4 for biscuit and 2 for margarine). For edible oil, one state in the South East (Anambra) seems very challenging, only 1 out of 6 companies visited agreed to participate. However, this challenge is not significant since the data points available for edible oil already tends towards data saturation (not many new information identified after six interviews).
- Overall, strict bureaucratic procedures are required to identify and interview potential participants in the industries. Informal contacts were leveraged to complete some interviews. However, some of the participants did not want to be identified and did not grant permission for their organisation name or brand to be mentioned in the study report.

47 Definition summarises several Nigerian institution definitions of SMEs, i.e. Central Bank, Fed. Ministry of Industry etc.

48 https://www.boi.ng/smedefinition/

3



3. Results

Background characteristics of interviewees. Interviews in the edible oil and biscuits value chains were done with medium scale players that have existing capacity of an average of 100 tonnes per day and most of them were operating at this capacity level. However, if technical and operational challenges occur, daily outputs may drop to an average of 50 to 60 tonnes daily. The dairy company is a small-scale business operating at about 5000 litres per day. Other businesses (plantain chips, baked products and other snacks) were mostly microscale with daily outputs of less than 1000kg. The margarine company is a large-scale company, however interviewees did not estimate the installed capacity or daily output for margarine. Other interviewees were stakeholders linked to the iTFA enabling environment, of which five were members of the iTFA TWG while two were private laboratories officials and one was a representative of a government laboratory.

Key informant interviews. Knowledge about TFA/iTFA is generally low among interviewees, especially among the MSMEs (Figures 5 and 6). Most members of the TWG appear to have some background knowledge about iTFA but may not have in-depth knowledge of how the iTFA occur in the food value chain.

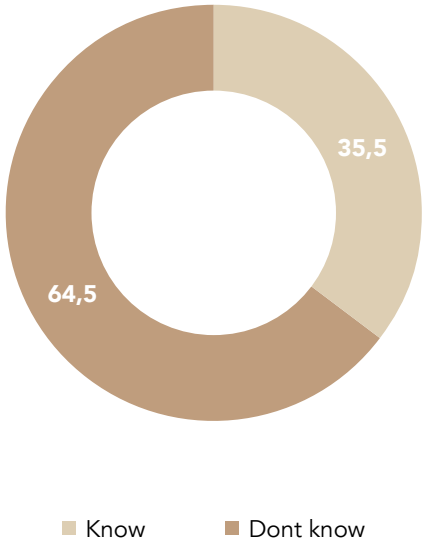


Figure 5: Knowledge of iTFA among study participants (knowledge of iTFA's existence and its definition)

64.5% of the interviewees had no knowledge of iTFA's existence and its definition.

3.1 Knowledge and perception around iTFA

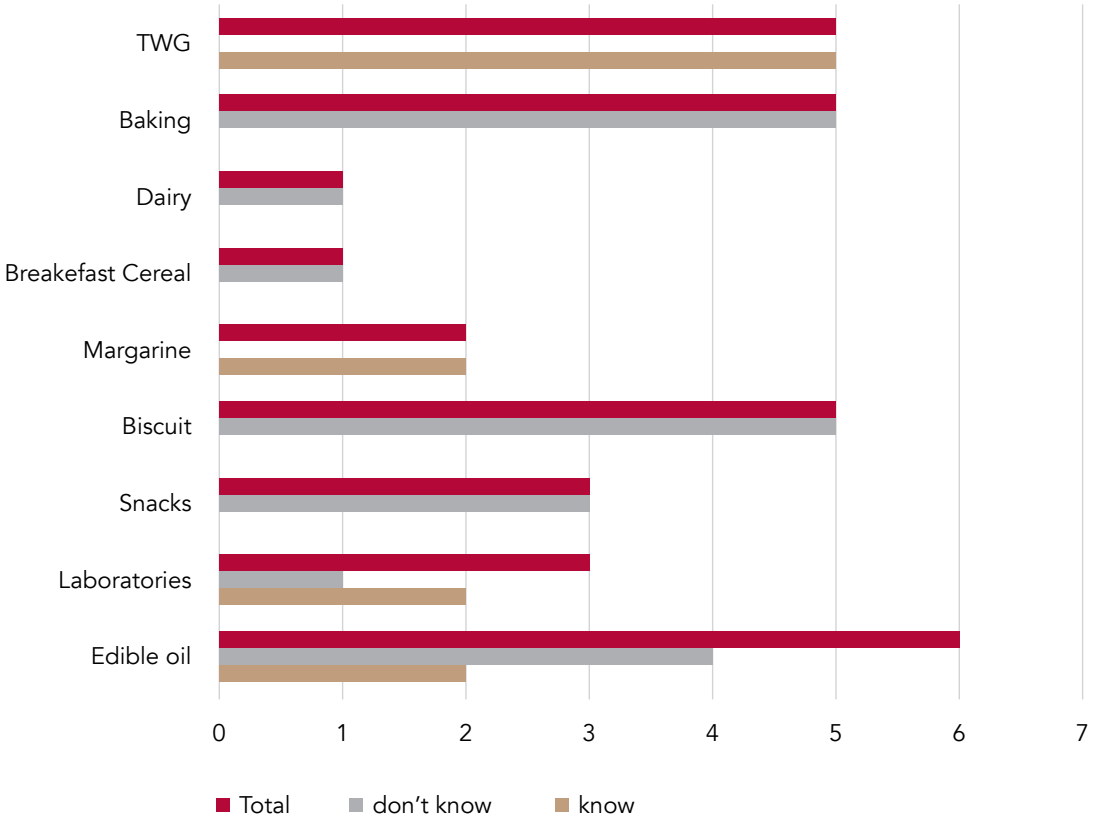


Figure 6: Knowledge of iTFA (knowledge of iTFA's existence and its definition) by study participants category/grouping

The most common perceptions and ideas about iTFA among the interviewees are listed below, reflecting the limited level of knowledge on this topic:

- Interviewees perceived iTFA to be a product and most interviewees often referred to the fact that they do not produce iTFA.
- Interviewees misconstrue iTFA to mean free fatty acids, distilled fatty acids (DFA), the fat (stearin) separated from the refining of Crude Palm Oil (CPO) after processing (KII- VO-D), rancidity produced as a result of continual reheating of oil, fatty acids or distilled fatty acids. "*I will say this is the first time I'm calling it trans fatty acid; I know fatty acids. Sometimes we call it DFA.*"- KII-VO-B
- Some perceived this as an attempt to discredit palm oil since it is produced by Africans and Asians: "*it is just the 'white men' trying to put some fear in people and make manufacturers not to sell their products*"-(KII-VO-A)
- A few participants (KII- VO-C, KII-VO-A) understand that trans fat is introduced as a result of trans isomerization of the poly unsaturated fatty acids (PUFA), or as a result of the breakdown of triglycerides at high temperature.
- There is a wide perception that it is 'bad fat' (even among those not very knowledgeable). However, only very few MSMEs know the health consequences of the consumption of iTFA. "*Now, healthwise, we are made to*

understand that PUFA is a good fatty acid that the body should consume because they tend to help the body to produce high density cholesterol (HDL) which the body can easily metabolise. But if the configuration changes from CIS to TRANS, the type of cholesterol that will be produced by the body will be different. Instead of the body producing HDL, it will now be producing the LDL, the one we call the bad cholesterol, low density lipoprotein and those are the ones that lead to..., arteriosclerosis and so many other diseases...health problems generally."

- There is a perception that trans fat will not become a problem until it reaches a certain threshold "*when it is less than 0.3 in the oil, it is not a problem*"-KII-VO-C.
- Interviewees perceive that different population groups may have a higher risk of exposures due to consumption pattern KII-VO-A, EE1-TWG. "*Nigeria has a very great capacity to consume "ororo (refined edible oil)" sometimes our companies in Ivory Coast and Ghana; they have to sell their 'ororo' in Nigeria. Yorubas are the highest, but Ibos are trying to meet up with the consumption level of ororo.*" – KII-VO-A.

Among the interviewees, the main source of information on iTFA is through contact with buyers of their company products who request low levels of trans fat, "*some guys threatened to stop buying our oil because of trans fat issue" "they were telling us to manufacture below 180°C*"-KII-VO-A. Other sources of iTFA related information is through participation in office seminars and personal research. Buyers who mention iTFA as a criterion for buying oil include Nestle (KII-VO-A, KII-VO-C) and Unilever (KII-VO-A). Cadbury was also mentioned as one of the companies promoting awareness on iTFA.

Participants were unanimous that awareness about iTFA among food processors is inadequate, hence the need to sensitise MSMEs and the general population (consumers) on iTFA. Interviewees producing 'secondary products' such as baked and fried products believe the focus should be on ingredient suppliers.[49]

Food perceived by interviewees to likely contain iTFA include margarine, biscuits, edible oils, milk (because most filled milk contains vegetable oil-KII-VO-A), noodles (frying is part of the process of manufacturing noodles), cheese balls, sausage rolls and fried products. Stakeholders also consider bread as a possible source of TFA, especially since it is a staple. The primary sources are considered to be hydrogenated oils and fats such as PHO and margarine while other products are considered as secondary sources.

Figure 7: Likely sources of iTFA in Nigeria

Major buyers of edible oil – which if it contains iTFA will result in end-products containing iTFA - are noodles manufacturers notably Dangote, Tummy Tummy, and Dufil (now refining their own oil so no longer buying). Other buyers of refined, bleached and deodorized (RBD) oils (especially palm olein) include manufacturers of cheese balls (Zubit foods), sausage rolls (Rapido) and bakeries. Interviewees in the edible oil refining value chain also noted that other buyers purchase stearin from them. There is the perception that margarine is produced from stearin and may, therefore, contain iTFA although it appears that stearin is used predominantly in the production of soap.

49 "Except that you are just telling me this now, I don't know there is any trans fat in the margarine; they don't even put it on their container, to say this is what this thing contains, the way drugs do. So, I think the major focus should be on the manufacturers. When manufacturers are forced to reduce the quantity of trans fat in all these products that we use to produce another thing, then when we go to the market to buy what we need as ingredients for our products, we will buy the right thing-KII-Bk-01."

3.2 Raw materials used by food manufacturers

For the five value chains assessed (edible oils, biscuits, snacks, baked products, and margarine) biscuit is the main product where there are indications that PHO is used. Specifically, PHO is used more in the manufacture of wafers and cream crackers (pictures below). Some bakers also indicated that some of the margarine imported from Malaysia might also contain PHO. However, further investigation is needed to substantiate this finding.

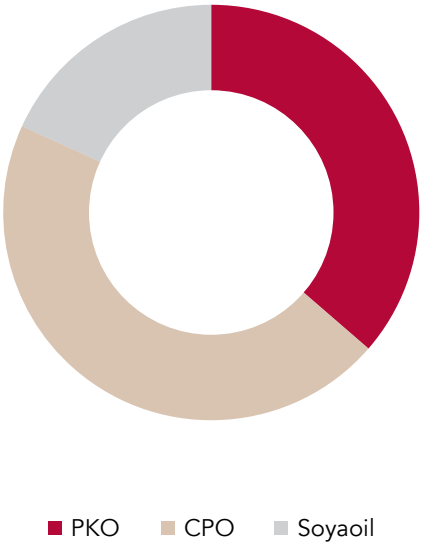


Figure 8: Common raw materials used by edible oil producers in Nigeria (Palm Kernel Oil PKO, Crude Palm Oil CPO, Soyaoil)

3.2.1 Raw materials used by edible oil manufacturers

Crude palm oil also called special palm oil, and palm kernel oil are the predominant raw materials used by edible oil manufacturers followed by soya oil. Other sources of raw materials for producing oil include ground cereals and shea butter which are not commonly used due to their limited availability. Shea butter is available in Chad and Burkina Faso, however conflicts in these countries limit the availability of shea butter. Other possible sources such as animal fat derived from cows and chicken are not commonly used due to high levels of saturation and its resulting health consequences. There were reports of the use of tallow oil (which is not considered edible) in food processing.

3.2.2 Raw materials used by biscuits manufacturer

There is no evidence of the use of hydrogenation in the refining of edible oil in Nigeria. Manufacturers import the PHO or Hydrogenated Vegetable Oil (HVO)[50] used in biscuit production from different countries including Malaysia, India, China.

Ingredients used in the manufacture of biscuits include creme, or spread, hydrogenated fats (especially in the production of wafers) and refined vegetable oils (e.g. PKO).[51] According to an interviewee, HVO is a shortening agent for biscuits.[52] Whey milk is also used by biscuits manufacturer because it adds some fat to the product as well as powder forms of emulsifiers, mono and triglycerides.

50 It is not certain if HVO mentioned by participants is fully hydrogenated or partially hydrogenated.

51 "There are different types of biscuits which include hard dough biscuit or soft dough biscuit, palm stearin, or hydrogenated fats can be used for the production of biscuits. However, the ideal one for waver is hydrogenated fat- KII-SN-O3."

52 KII-SNB-08-A

The interviewees estimate average consumption of fat in the processing of biscuits as follows:

- 30-45 tonnes of palm stearin in five days for the production of an estimated 500 tonnes of biscuits, and wafers.
- 30-45 tonnes of refined PKO in five days for the production of an estimated 500 tonnes of biscuits, and wafers.
- 20 tonnes of palm olein in two weeks for the production of an estimated 500 tonnes of biscuits, and wafers.
- 30 tonnes of hydrogenated fats will be used for about three weeks to produce an estimated 1800 tonnes of wafers and biscuits.[53]

3.2.3 Raw materials used by bakers and snacks manufacturers

Baked products, especially cakes and bread, may also represent potential sources of iTFA in the food supply in Nigeria. The quantity of margarine/butter used in cake and bread production appears to be more than the quantities used in other baked products. The bakers interviewed are making cakes, cookies, doughnuts, meat pies, bread, sausage rolls, and chin chin (crunchy deep-fried snack). Snacks manufacturers interviewed are producing peanut snacks, plantain chips and other products. The most common baking fat used by bakers is margarine. In a few instances, butter is used for baking of products to supply special orders (which are often more expensive) to wealthier customers. Edible oil is also used in making moist chocolate cakes and by those who sell fried products like chin chin. Brands of margarine used include Topper Margarine, Balido, English Butter, Cookbrand, Clemantis, More, Divine, and Simas. Other brands mentioned mostly by participants from one State (Plateau) include margarine products such as STK margarine, NDK margarine, and Vitali. The margarine products are available in cartons of 15kg pack sizes.

- Most commonly purchased Topper brand size is 10kg and most interviewees reported they finish 10kg in about 2 to 3 weeks depending on the volume of order received. During high volume sale, 10kg of margarine can be finished in one week.
- In making chin-chin an estimated 200g of margarine is used for 1.5kg of flour.
- Very few grams of margarine/butter are used in making sausage roll.
- For 350kg of flour used daily in baking bread, the average margarine use reported is 9.5kg.
- An interviewee estimated that they use about 10 litres of oil in frying about 100kg of plantain chips. While for other snacks, about 20 litres are used for about 12 to 18 Kg of products. For peanut snacks, an estimated 25-30 litres are used for about 200kg of products. The peanut is later de-oiled to reduce the oil level in the final product. In addition to oil, about 1kg of Simas butter is added. Average batch frying per oil is between 4 to 7 times.

Manufacturers of fried food products increase iTFA content in their products when they use the same batch of frying oil more than three times, therefore in addition to choosing raw material without iTFA (or below 2g per 100g of fat) manufactures of fried snack and baked foods should not use the same oil after two rounds of frying.

Interviewees reported that most of the margarine and butter used in Nigeria are imported products.[54] Various brands of margarine exist in Nigeria markets with various prices and quality. Interviewees purchase products based on the desired end products it offers their baked products, mostly unaware of the margarine/butter's PHO content.

The most known and recognised edible oil brand among the interviewees is King's brand however they estimate that marketers might sometimes sell unbranded oil packaged as King's brand oil. Interviewees believe that alternative oils are either of lower quality or more expensive (e.g. olive oil). Other brands mentioned include Solive groundnut oil and Power Oil.

53 KII-SN-03

54 Topper and More are from Holland, but there are some from Malaysia, but most of the ones from Malaysia, I think they are the hydrogenated oil, they are palm oil that is just heated and turned to margarine" KII-BK-03

3.2.4 Raw materials used by dairy manufacturer

The dairy manufacturer interviewed had products which include fresh milk yoghurt, sweetened millet, ice cream and pasteurised fresh milk. The raw materials used include ice cream powder, treated water, fresh cow milk, sugar and stabiliser.

3.2.5 Raw materials used by margarine manufacturer

The margarine manufacturer interviewed did not provide information on the raw materials used in the manufacture of their margarine or spread. Choices of raw materials for margarine manufacture are influenced by market force and demands, availability and company brand.

- Market force and demand appear to be the key driving force. Most of the interviewees across the food value chain mentioned customers and consumers choice as the key driver of what they produce. Some set their production based on orders received from buyers, and others produce 100% of soya oil to meet the demand for heart friendly oil by consumers.
- The availability of raw materials within Nigeria and the proximity with the processing plant is another driver. There is a wide abundance of crude palm oil (CPO) and palm kernel oil (PKO) as well as crushing mills in many locations across Nigeria especially in the Southern States (Akwa-Ibom, Rivers, Abia, Imo, and Enugu). Some of the suppliers of CPO and PKO identified by interviewees include Trendy oil at Ogbuaku in Imo state, SanSavanna in Enugu state, Protec, Agro Ideas in Akwa Ibom, Daily Beverages in Awka. The availability of raw material is also dependent on importation, Malaysia is the major country mentioned for imports of palm oil and PHO. For the baking value chain, interviewees said "*availability is the major factor in choosing the margarine. Cost and quality are also other things that may be considered.*"[55]
- Seasonality also influences the choice of raw materials and sometimes the volume of products manufactured.[56]
- Other factors include company choice and branding. Manufacturers are known for specific brands and often prefer to maintain the relationship with the brand. The composition of the raw materials is another influencing factor.
- For the biscuit manufacturer and the bakers, the cost is a major influencing factor for the choice of raw materials, other factors are the desired texture of the final products and trust in the product/brand.
- Other influencing factors – especially for imported materials – are the economic situation, political factors and fiscal policies.

The main challenge experienced in sourcing raw materials locally is finding good quality material. Key quality parameters include an acceptable level of free fatty acid (FFA) (5%), and the melting point (below 35°C).

55 KII-BKB-AI
56 KII-SN-01

3.3 Entry points for iTFA replacement in Nigeria

Table 5. Typical process conditions for edible oil deodorization[57]

"Optimal process parameters depend on the type of oil (bleached and refined oil specifications) and the refining process applied (chemical or physical), but the limitations of available deodorizing equipment and the need to minimise operating costs are also determining factors. The typical range of the different deodorizing process parameters is given in this table."[58]

Parameter	Range	Comment
Temperature	160-260°C	Lower temperature (<200°C) for heat- sensitive oils (e.g. cocoa butter, fish oil) to avoid too much degradation of omega-3 fatty acids (fish oil) and negative effects on crystallisation characteristics (cocoa butter) Higher temperature (260°C) for FFA stripping/heat bleaching (e.g. physical refining of palm oil) Trend towards lower deodorizing temperature (230-240°C)
Time	5 min – 4 hr	FFA stripping (with packed column): 5 min (no deodorization) Deodorization of soybean/canola oil: 20-90 min Full deodorization of fish oil: 2-4 hr
Pressure	1.5 – 5 mbar	Most common range: 2-4 mbar Low pressure required for stripping of FFA and volatile contaminants (pesticides, light PAH, etc.) Trend towards lower deodorizing pressure. This allows same stripping efficiency at lower temperature or with less stripping agent Higher cost to create lower deodorizing pressure
Stripping steam	0.5 – 3%	Depending on type of oil and refining mode Steam is the most commonly used stripping agent (efficient – lowest cost) Stripping with nitrogen is not applied industrially

57 Wim De Greyt, R&D Manager, Desmet Ballestra, Zaventem, Belgium, "Deodorization", AOCS Lipid Library.
58 Wim De Greyt, R&D Manager, Desmet Ballestra, Zaventem, Belgium, "Deodorization", AOCS Lipid Library.

3.3.1 Stages in edible oil processing in Nigeria.

The processing of edible oil often begins with crude oil obtained from oil seeds (CPO, PKO, Crude Soya oil). The processing steps for the three commonly produced edible oils in Nigeria – as described by the interviewees - is presented in Figures 10, 11, and 12. Oils are refined to remove pigments, metal particles, gum, and reduce moisture content. Most edible oil refining plants are made up of at least three units which are the pre-treatment unit (where degumming and bleaching take place), deaerating unit, the deodorization unit, and deacidification unit. The oil is then advanced to a fractionation plant for separation where required (for CPO especially). Preliminary processes include proper storage, filtration, heating and drying of the crude oil.

Important variables related to the introduction of iTFA into edible oil processing include temperature, pressure and time. The process of deodorization of oil may represent the most likely entry of iTFA into the refining of oil simply because this stage requires very high temperature (Table 5).

Temperature: High temperature has been proven to negatively impact iTFA levels: "*The deodorization of vegetable oils at temperatures above 200 °C was shown to yield up to 3% TFA (as percentage of total fat) due mainly to geometric isomerization of the all-cis linoleic and linolenic acids.*[59] *Similarly, deep frying at temperatures that exceeded 200°C also led to the isomerization of these acids.*[60] *Heating vegetable oils at such elevated temperatures resulted in approximately 14 times more products of isomerization of cis linolenic acid […] than those of cis linoleic acid […].*[61]" Interviewees perceive that the likelihood of iTFA introduction into edible oil is the lowest with CPO followed by PKO. Soya and groundnut oils are more likely to have iTFA if processed at a very high temperature. Corn oil and sunflower oil are sensitive and highly unstable at very high temperature. Interviewees perceived that it is impossible to refine edible oils (CPO and PKO) at a temperature below 200℃-240℃. They estimate that only deodorization for 'lighter oils' like soybeans might be possible at 200℃, 220℃, to 240℃. According to J. Zhang et al., oils can be refined slightly below 200℃ (180℃): "*In the refining process, vegetable oils are commonly heated up to 60°C and 100°C before deodorization. During the deodorization step, the temperature is increased to 180-270°C (for about two hours, with variation from case to case.*"[62] Some of the technical challenges that may limit the reduction of processing temperature especially at the deodorization stage are the need to completely remove colour and gum (especially for CPO) and the need to reduce the (FFA) levels. Overall, from the processors perspective the main issue with the processing temperature is the flow rate of the oil, the rate of output expected to achieve the operating capacity or targets expected, and the quality of the oil that can be certified by the laboratory.[63] There are several cost implications (human, financial, logistics) for a processor who seek to reduce processing temperature to reduce TFA content. Eckel et al. for example reviewed the full cost implications of removing trans fat among some snack food manufacturers in the US, "*the reformulation of 187 products made in 46 plants (requiring 7200 man hours) required over 240 analytical tests and 24 consumer studies at a cost of USD25 million.*"[64] Therefore, it can be complicated for edible oil processors to lower the temperature levels in order to achieve lower levels or trans fat free materials. For solvent fractionation, high capital and processing costs are estimated to be the main reason for its low usage.[65] While for chemical interesterification, oil losses and effluents resulting from the

59 Ackman, 1974; Buchgraber and Ulberth, 2002; Wolff, 1992 in Trans fats replacement solutions/editor, 2014, Dharma R. Kodali, p. 93

60 Sebedio et al., 1996 in Trans fats replacement solutions / editor, 2014, Dharma R. Kodali, p. 93

61 Sebedio et al., 1996; Wolff and Precht, 2002 in Trans fats replacement solutions/editor, 2014, Dharma R. Kodali, p. 93

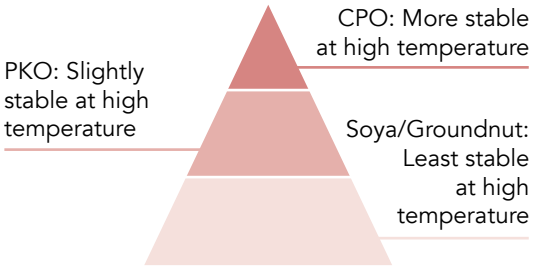
62 Trans fats replacement solutions / editor, 2014, Dharma R. Kodali, p. 341.

63 "So, you can process between 200°C and 240°C. The only thing that will happen is that the time of exposure, the resident time of deodorization will increase, and it will drop your volume per day." KII-VO-C

64 Eckel et al., 2007 in Trans fats replacement solutions / editor, 2014, Dharma R. Kodali, p. 254

65 Trans fats replacement solutions / editor, 2014, Dharma R. Kodali, p. 20

process increase its cost for the companies. Additionally national regulations can diminish the number of affordable replacement solutions available, for example in India regulations around iTFA content for Vanaspati ghee and bakery shortening were introduced without deleting requirement to have a melting point limit of 41°C which limits the number of solutions available for iTFA replacement.[66]



3.3.2 Stages in biscuit processing in Nigeria

Processing of biscuits may represent one of the main sources of iTFA into the food supply chain in Nigeria.[67] As described earlier, PHO/HVO is one of the raw materials used in the production of biscuits. The processing steps used in the manufacture of biscuits are: 1) weighing of all ingredients, 2) mixing, 3) creaming (for wafers), 4) moulding, 5) baking (lowest baking temperature is 220°C, 6) cooling, and 7) perforation.

3.3.3 Margarine processing in Nigeria

Interviewees in the margarine processing sector report having replaced iTFA and not using hydrogenation as part of their process, they report using fractionation method. Therefore, they do not anticipate iTFA content in the final products. The fractionation process described involves the separation of the oil by cooling and crystallisation without allowing the full formation of large crystals.

3.3.4 Common issues in baking and snacks processing in Nigeria

Some of the relevant issues and processing parameters adopted by bakers and snacks manufacturers are:

- Temperature: the reported temperature for baking cake is 165°C-170°C. Most of the micro scale snacks manufacturers do not use devices that have temperature control in frying their product.[68] An interviewee reported using an industrial deep fryer with a temperature gauge; he also uses infra-red temperature gauge that can be held up on top of hot oil to determine the temperature.[69]
- Bakers do not have nutrition labels on their product, they only have business stickers with their addresses and phone numbers.

66 "With the removal of the melting point limit of 41°C for vanaspati and bakery shorting by the Food Safety and Standards Authority of India (FASSAI), it would be possible to develop a wide range of low-trans or trans-free products.", Trans fats replacement solutions / editor, 2014, Dharma R. Kodali, p. 381.

67 "When we talk about iTFA, I think it may be of concern more in bakery products which tend to use hydrogenated or PHO in their products. I don't know about Nigeria, but at the international level, this is the main concern." KII-Mg-02

68 "What I do is there's a particular texture in terms of look, the chin-chin should be when heating, golden yellow brown which is the same colour for frying anything-whether chicken or plantain, So what I do is I drop just one in the oil, when it comes up immediately, then the oil is ripe for frying." KII-Bk-01

69 KII-SN-02

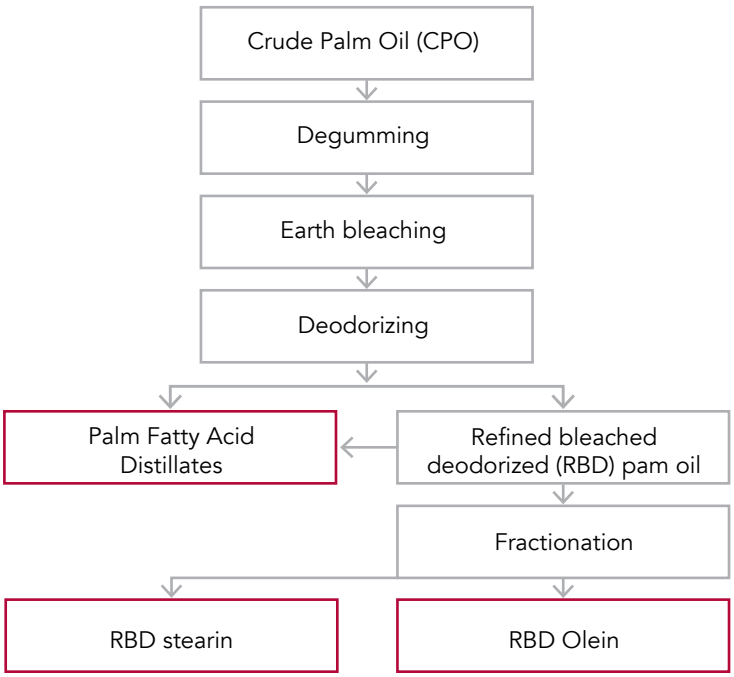


Figure 10: Flow diagram for the physical refining of crude palm oil into edible palm olein

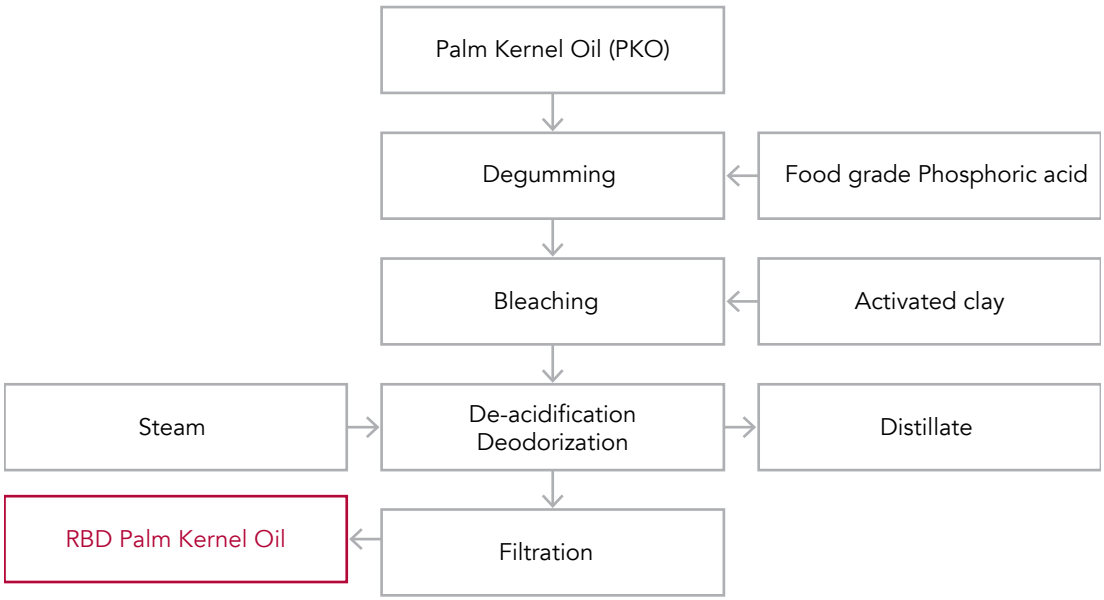


Figure 11: Flow diagram for the physical refining of palm kernel oil

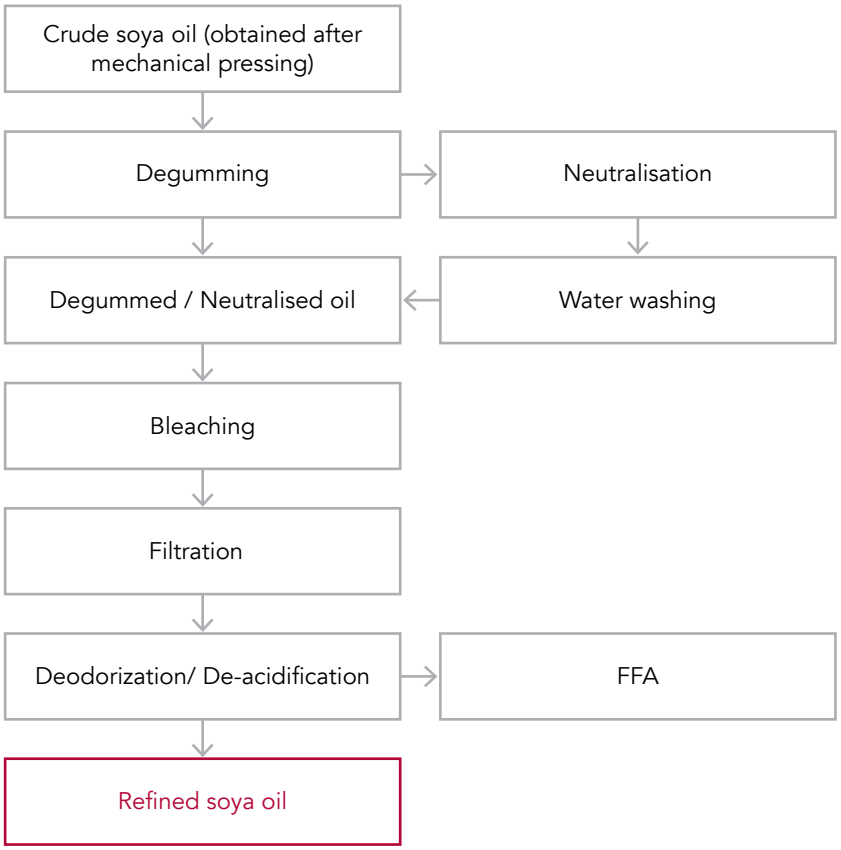


Figure 12: Flow diagram for the physical refining of Soybean oil

3.4 Interviewees' perspectives on the feasibility of replacement options for iTFA

The need to redesign plants or change processing methods to accommodate new raw materials or methods of processing is considered a major challenge that will limit the adoption of replacement options. Other challenges may include market launch that may be associated with making changes to the existing brand and other costs such as research and development, personnel training, engagement of an external consultant for product formulation, etc. For the edible oil value chain, interviewees feel that replacement options like cold pressed oil, a technology used in the processing of virgin olive oil may be explored. The need to redesign existing plants to accommodate changes and the associated cost of the process changes are the biggest challenges anticipated by the interviewees in edible oil manufacturing, biscuit value chain and the margarine sector.[70] Also, for interviewees from the margarine value chain: "*the replacement of hydrogenation with fractionation is expensive and consumers may not know the difference between the hydrogenated brand and the fractionated one and may therefore complain that the fractionated one tend to melt when exposed to high temperature and may think it is not good because of that.*"[71] An interviewee raised the issue of sustainability regarding the use palm oil as a replacement solution and the need to find a global answer to this challenge.[72]

Most MSMEs feel that reformulating products may require the implementation of several steps from organisational regimen, to engineering, design, implementation, etc. With sufficient funding, this may take an average of 6 months, with a longer duration in case of limited funding available. The durations for the installation of various reformulation equipment will also impact the timeline for trans fat free production. Additionally, regulatory agencies' requirements (e.g. SON requirements) may prolong the reformulation process.

In addition to the technical and operational challenges and financial challenges faced by MSMEs, overarching challenges in the enabling environment such as economic recession, limited power supply, high cost of fuel may limit iTFA replacement efforts. For instance, an interviewee reported that his company had not produced edible oil since November 2018 due to an energy issue and an unfavourable economic situation.

The huge volume of unbranded oil in Nigeria may make the labelling regulations for TFA expected to be released by NAFDAC difficult to implement. Many of the MSMEs in the edible oil value chain have unbranded products. They sell to other commercial processors which produce manufactured goods and to buyers which purchase in bulk and dispense the oil through open market outlets. There were other quality issues relating to food safety identified in the sale of unbranded oil with possible contamination of edible oil by vendors and marketers.

Some companies, however, produce branded oils considered to be for domestic use and some of these products include nutrition labels with - in some instances - claims on trans fat content. Several packaged edible oils identified in supermarkets include trans fats claims.

70 "I will tell you to an extent it has nothing to do with the organoleptic, but the most important thing is that by the time you change, that means maybe some of our machines will be outdated… because of that fact that we don't have hydrogenated fats, that particular component, of the plant that dispenses crème for wafer, won't function and by implication the entire plant will not be used." KII-SN-03

71 KII-Mg-01

72 "There is now an increase consumption of palm products even in the developed economies and this is currently fixing the gap in iTFA replacement. The problem comes when you talk about sustainable palm production because people are going to cut all the palms".

Some products such as biscuits and some snacks are mostly packaged products with nutrition labels. Margarine is also sold in packaged containers which may be of commercial sizes or in small pack sizes for domestic use. Most of the small packs have nutrition labels. Interviewees in the baking value chain reported that they do not include nutrition labels on their products.

The new regulations specify that where "Trans-Fat free" claim is made on the label or in an advertisement, the content of Trans-Fat shall be less than 1 gram per 100 grams of the total fat or oil in the final product.

Some interviewees believe that the use of nutrition labels and claims as well as the practice of endorsement are approaches adopted by manufacturers to promote their brands. Most participants perceived that the claims might not necessarily reflect the content of the product.[73]

Interviewees in the baking value chain reported that they do not include nutrition labels on their products.

3.5 Capacity building and incentives for MSMEs to replace iTFA

Key needs to support MSMEs in replacing iTFA include training and sensitization, provision of technical support to implement improved technologies or processes that can reduce or eliminate iTFA, and financial support for the procurement of relevant equipment.

3.5.1 Suggested support to MSMEs

- Stakeholders suggest training and sensitization as the first way to improve the level of awareness about iTFA among business. Training content should focus on how to design and implement the right producing and manufacturing processes to avoid the introduction of iTFA across the food value chain. MSMEs think that they will benefit from information on new technologies available to modify their processes to reduce TFA. They believe that if there is a combination of regulation and available alternatives, food processors can easily adopt best practices around iTFA.[74]
- Provide support to MSMEs to purchase relevant equipment to put in place quality control systems. Equipment support could encompass not only the implementation of iTFA replacement solutions but also ways to mitigate cost implications such as the possibility to use frying oil to produce energy and therefore to prevent iTFA creation

73 "An edible oil product that has trans fat free… or cholesterol free may not be true. But during branding, manufacturers identify some of the things that will make their products to sell faster in the market." KII-VO-D "These days you can buy endorsement, the endorsement is for sale now, now all those things are rubbish, regulators should be working, challenging processing firms and inform the public." KII-SN-O2.

74 "The best thing will be to have an alternative, for instance, look at the issue of bromate in bread, - sometimes what is also driving these things is cost, people will use saccharine instead of sugar because sugar is more expensive." KII-Bk-03

through excessive use of same oil batch in frying processes.

- Provide support to MSMEs in the analysis of their products to determine the actual level of TFA[75]. An interviewee suggested that for MSMEs especially SBN members, GAIN could provide support for the analysis of the products and businesses could be provided up to 50% support for the cost of analysis.[76]
- Another support requested especially by members of SBN Nigeria is the recruitment of experts such as food technologists to support companies in replacing iTFA when relevant.

3.5.2 Suggested incentives to MSMEs

Stakeholders interviewed highlighted the benefit of getting additional data on iTFA content in current products available in the Nigerian market.

Strong quality control from government agencies, especially NAFDAC and SON, was mentioned by the interviewees.[77]

Interviewees believe that a reward system for companies that eliminate or reduce iTFA from their product will provide a level playing ground.[78] If one company reduces iTFA and a company producing similar products does not, those that have reduced iTFA may operate at a loss since consumers are sensitive to even a marginal increase in prices. An interviewee suggested that Nigerian companies should receive a certain amount of government subsidies for implementing quality management systems that support iTFA replacement. Some of the certifications mentioned include ISO 9001, 22000 (for food quality and safety), and 2015. GMP and quality systems will ensure that quality manuals are in place for all processes and used to guide the storage of ingredients such as bleaching aids, citric or phosphoric acid as well as to identify the sources of all raw materials used in processing.

Nationwide awareness by regulatory agencies such as SON and NAFDAC is also considered as a form of incentive for manufacturers to replace iTFA. Several interviewees stated that if companies know that consumers will buy their product if it is within acceptable limits of iTFA, they will try to reduce iTFA and include it on their product label to increase sales.

Other best practices recommended are the promotion of nutrition labelling, making it mandatory for both locally made and imported products to include iTFA levels on their label. There is also a need to promote the active use of a certificate of analysis in raw materials purchase.

MSMEs believe that addressing the issue of stiff competition caused by cheaper oils imported from other countries, especially for the edible oil value chain. If local companies comply with available regulations and the imported products are not checked, consumers may be inclined to buy less expensive oils in the market, and this will discourage local MSMEs

Some interviewees also believe that in-country manufacturing of PHO or similar alternatives can be an incentive to manufacturers that import PHO.[79]

75 "Because hardly...I don't think there's a place in Nigeria you can do Trans fats analysis, I know for our organisation, we send samples abroad to determine whether we have Trans fats in the oil." KII-VO-C)

76 KII-SN-02

77 "There should be a standard template for production that has to do with vegetable oil and the use of butter margarine and all that." KII-SN-03

78 "*Only if there's an incentive that if we analyse your product and it contains no trans fat or within the allowable level limits, there's an award, or there's money to be given.*"

79 "Best incentive is to do a research for an industry to be able to produce PHO in Nigeria. Regulators in Nigeria can have a control over the production of PHO if locally manufactured. It is currently difficult to control iTFA levels in PHO because the product comes from different countries." KII-SNB-08-A.

3.5.3 Laboratory capacity of MSMEs

Interviewees in the medium scale enterprises groups for edible oil and biscuits reported that standard laboratories exist within their manufacturing premises. None of the MSMEs in-house laboratories currently determine iTFA levels in products but they conduct other routine tests. Only one interviewee stated that his organisation has tested edible oil for iTFA by sending samples to an external laboratory in South Africa.[80] The routine tests carried out by MSMEs are presented below:

- Edible oil value chain: routine tests carried out assess FFA, moisture content and iodine value of the oil. Oil samples are collected hourly during the production process and analysed to monitor the required parameters in the oil. The laboratories serve as the quality control department and certify the products to meet all relevant parameters before the product moves to the storage tank.
- Biscuit value chain: routine tests conducted on raw materials assess rancidity, FFA, acid value, cholesterol and melting point. Finished products are tested for the acidity of the extracted fat. Interviewees also mentioned physicochemical analysis, microbial analysis, sensory evaluation and other required tests.
- Baking and snacks value chain: no in-house laboratory, most are micro scale and outsource analysis to external laboratories (approved by SON) mostly to fulfil regulatory requirements such as product registration with NAFDAC.
- Dairy value chain: the organisation has an in-house laboratory but also send out samples to external laboratories for analysis. The routine tests conducted include 'clot on boiling', which is a qualitative test to determine the level of saturation in the milk. It indicates that the milk is saturated, or the acidity is high, and some microbial growth has started to occur. Lactose scan is also used to analyse the protein and fat contents of the milk and added water.
- Margarine value chain: the interviewees did not provide details of the routine tests carried out. They, however, noted that iTFA determination is not a routine analysis and not carried out since the processing raw material and method is not expected to introduce iTFA. Although iTFA determination is conducted to meet regulatory obligations.

Stakeholders reported that no known laboratory within Nigeria currently analyses iTFA levels in edible oil or other products. Many interviewees also believe that facilities that determine fatty acid profile in food in Nigeria are rare. Manufacturers are not obliged to check the levels since it is not a requirement by NAFDAC.

3.5.4 Laboratory capacity of government agencies and private laboratories

Stakeholders perceive that gaps exist in laboratory testing and analysis of TFA in Nigeria. Many interviewees reported that NAFDAC is, however, actively taking steps to address these gaps and have procured equipment for testing and analysis of TFA. The Laboratory Service Directorate of NAFDAC is currently developing testing methods and has been able to establish association of official agricultural chemists (AOAC) methods suitable for the testing and analysis. Laboratory stakeholders stated that gas chromatography with a flame ionization detector is the recommended test equipment for the determination of trans fat. Officials interviewed in one government laboratory, and one private laboratory stated that they have gas chromatography capability. However, the appropriate testing column is required, as well as capacity development for laboratory analysts. A private sector interviewee estimated that the estimated cost of the required column is about one million NGN while for the standards, the estimated cost is about five hundred thousand NGN. An average life span for the column is about five years if well maintained, and the standards can be used for up to two years. NAFDAC has initiated plans to procure the appropriate testing column and reference standards.

None of the laboratories interviewed have received food samples for determination of

80 KII-VO-C

TFA levels as at July 2019. Companies find it difficult to invest in the procurement of needed column and standards for TFA determination if there is no prospective market demand on iTFA testing. Mandatory requirement on iTFA testing is considered by the interviewees as the most effective way to develop capabilities in this area.[81] Interviewees estimate that the cost per sample for the determination of iTFA in food products should be about NGN 40,000 to 60,000.

After the implementation of laboratory capacity to asses iTFA content in products, regulatory actions will be needed to address products with iTFA content above 2g/100g of fat. Similarly, if no iTFA is in the product, then the processing technique used by such manufacturer can be recommended as best practice. All the steps require convening stakeholders to determine the best operational procedure that can be adopted. In the short term, NAFDAC plans to analyse three products considered to be major sources of iTFA which are edible oil, margarine and butter.

Samples tested in government laboratories can be sent to external locations for confirmation if industry stakeholders do not agree with test results presented by the government agencies. In such instances, the industry will be required to pay for the confirmation analysis. Interviewees suggested that GAIN or other partners may adopt a similar laboratory assessment and improvement programme than the current programme on large-scale food fortification.

Currently most of the interviewees believe that in Nigeria, there are currently no policies on iTFA replacement and that it is the responsibility of regulatory agencies - NAFDAC and SON - to put in place necessary regulations and guidelines on iTFA in Nigeria. Some interviewees feel that if Codex does have a standard on iTFA, SON may likely adapt such standards. Most stakeholders believe that NAFDAC is best positioned to develop regulation on iTFA, especially in the aspect of product labelling. Many interviewees, however, expressed concerns on capacity within NAFDAC to analyse and measure iTFA.

3.6 Interviewees' recommendations for a stronger policy and implementation landscape for iTFA replacement

Interviewees recommended that the sequence for strengthening the policy and implementation landscape for iTFA replacement in Nigeria should include the following:

- Establish the sources of iTFA in the food supply in Nigeria and organise a range of stakeholders to discuss the findings. Engagement with manufacturers for replacement, consumer awareness, and other activities will rely on data on the level of iTFA found in commonly consumed foods in Nigeria. Some interviewees believe that levels of iTFA in food products sold in Nigeria are higher than iTFA levels in similar markets is key to making progress.[82] Other interviewees believe that product testing should first focus

81 "For example, when water analysis became mandatory for all manufacturers, laboratories started to develop their workforce capacity on water analysis and increasing analysis parameters by day. "with vegetable oil, the concern is vitamin A and other analysis like FFA, acidity, rancidity, the peroxide value and other metals that cause spoilage. People to request to test for iTFA." KII-EE4-Lab

82 "So for now, I think that sampling and analysis is the single most important thing so that when we talk, at least we have things to show."KII-EE5 "Researchers, regulatory agencies and other relevant stakeholders should conduct analysis on food products and have a clear position on TFA levels in products, and engage with manufacturers to ensure that the levels of TFA in food are within acceptable limits and make them indicate it on their products so that bakers can make the decision of which products to purchase."KII-BK-01

on the primary sources rather than testing secondary products such as bread, cake, chin chin and other snacks.

- Interviewees believe that key actors should prioritise policy development since it will provide the needed direction to jumpstart efforts to raise awareness about the dangers of iTFA. While NAFDAC has recently updated its fats and oils regulations to include iTFA labelling, some interviewees believe this should be complemented by a policy from the Nigerian Federal Ministry of Health. Some interviewees also believe that the multi stakeholder action plan on NCDs has one of its chapters dedicated to TFA regulation, but the plan is yet to be endorsed for implementation. Interviewees believed that the Nigerian Medical Association is actively carrying out advocacy activities to promote policy development. Most of the interviewees are in favour of policy options on iTFA replacement, which address voluntary reduction and a set limit of 2g per 100g for iTFA content. Interviewees do not believe that Nigeria is currently able to implement a total ban on iTFA based on government capacity to endorse iTFA regulations for all local and imported products with a risk of lower cost iTFA products replacing high cost compliant products.[83]
- Interviewees believe that massive awareness raising should precede any enforcement efforts. Interviewees think there is limited effort to encourage consumers to make a healthy choice with regards to iTFA,[84] and regulatory agencies such as NAFDAC and SON should, therefore, prioritise such effort. Suggested implementation plans include the promotion and monitoring of nutrition labelling, for instance through the use of traffic system (a form of front of pack labelling). Other actors will require sensitisation on this issue, notably enforcement agencies such as police, civil defence, and customs as well as manufacturers.[85]Overall, MSMEs should know how iTFA occur in their processes and know about alternative processing methods and alternative materials that exist. Manufacturers should be made aware of TFA regulations as they evolve.
- Interviewees suggest that regulatory agencies should develop and implement clear strategies for tracking manufacturers in the informal sectors.[86] This should take into consideration the compliance of street vendors regulated by local governments rather than the federal government.
- Interviewees call for effective multi-stakeholder collaboration on iTFA replacement. For example, non-profit organisations could donate testing equipment for iTFA level assessment. The private sector – especially multi-national companies – are identified as a source of technical expertise and as a change agent to support MSMEs in replacing iTFA.

The private sector - especially multi-national companies - are identified as a source of technical expertise and as a change agent to support MSMEs in replacing iTFA.

83 "If Nigeria bans PHO, manufacturers may resort to illegal imports causing an increase in the cost of production and consequently increase in the cost of products. The resultant effects may include mass job loss." KII-SNB-08-A

84 "If people are already empowered by themselves to make informed decisions, I think that is very important." KII-EE5

85 "Regulatory agencies and other stakeholders should sensitize industry actors on the sources of TFA in the food supply chain, the acceptable levels of TFA allowable in food products; the best-practices for TFA replacement, specific replacement options available to each value chain or should be developed and used in sensitizing private sector players." KII-EE1

86 "It will be very important for them to have adequately trained personnel with the necessary tools for monitoring and conduct regular monitoring and visits to industries and retail markets-KII-EE7."

3.7 Stakeholders landscape for iTFA replacement in Nigeria

Many stakeholders believe that the Nigerian Medical Association led the initial efforts to raise awareness on iTFA reduction in Nigeria.[87] The Nigerian Medical Association, in partnership with NAFDAC, convened relevant stakeholders and set up a iTFA reduction technical working group which serves as a forum for intersectoral coordination of efforts to promote iTFA replacement in Nigeria. The Technical Working Group aims to develop policies and regulations on how to address iTFA in Nigeria. Box 2 presents the current membership of the Technical Working Group based on the information provided by the interviewees.

The planned activities of the Technical Working Group include the following

- Conduct a survey, a chemical, and biochemical analysis of food suspected to contain iTFA (mainly margarine and vegetable oils) to determine the actual iTFA levels.
- The Nigerian Public Health Physicians plan to assess the population intake of foods found to contain iTFA and to show results through various population sub-groups.
- Study the experiences, challenges, and learnings of countries that have policies and legislation on iTFA.
- Continuously advocate for iTFA removal by providing expert advice and briefing or developing policy briefs to engage with government.
- The Technical Working Group also plans to create a budget line for Federal Competition and Consumer Protection Commission in the proposed iTFA work-plan. The Technical Working Group hopes that once such a budget is in place, the Federal Competition and Consumer Protection Commission will use the funds to kickstart consumer awareness activities.

Box 2: Current membership of iTFA reduction Technical Working Group (TWG)

- Nigerian Medical Association (NMA)
- National Agency for Foods and Drugs Administration and Control (NAFDAC)
- Standards Organisation of Nigeria (SON)
- Federal Ministry of Health (FMOH)
- Federal Competition and Consumer Protection Commission (FCCPC)
- Nutrition Society of Nigeria (NSN)
- Nigerian Institute of Food Science and Technology (NIFST)
- Nigeria Heart Foundation (NHF)
- World Health Organisation (WHO)
- Global Health Advocacy Incubator (GHAI)
- National Bureau of Statistics (NBS)
- Ministry of Women Affairs
- Media
- Academia (the University of Benin, University of Abuja) and Nutritionists
- The Institute of Public Analysts of Nigeria (IPAN)
- National Assembly Representative (Chairman of Senate Committee on Health)
- Ministry of Budget and National Planning

87 "The Nigerian Medical Association launched the TWG in the year 2018 as an offshoot of the ICON (Improving the Cardiovascular Health of Nigerians -ICON) project of the Nigerian Medical Association." KII-EE1

The Global Alliance for Improved Nutrition (GAIN)/SUN Business Network, Global Health Advocacy Incubator, and WHO are among the organisations implementing activities for iTFA replacement in Nigeria, they all receive funding from Resolve to Save Lives, an initiative of Vital Strategies, to do so. Their complementary Nigerian activities are summarised below:

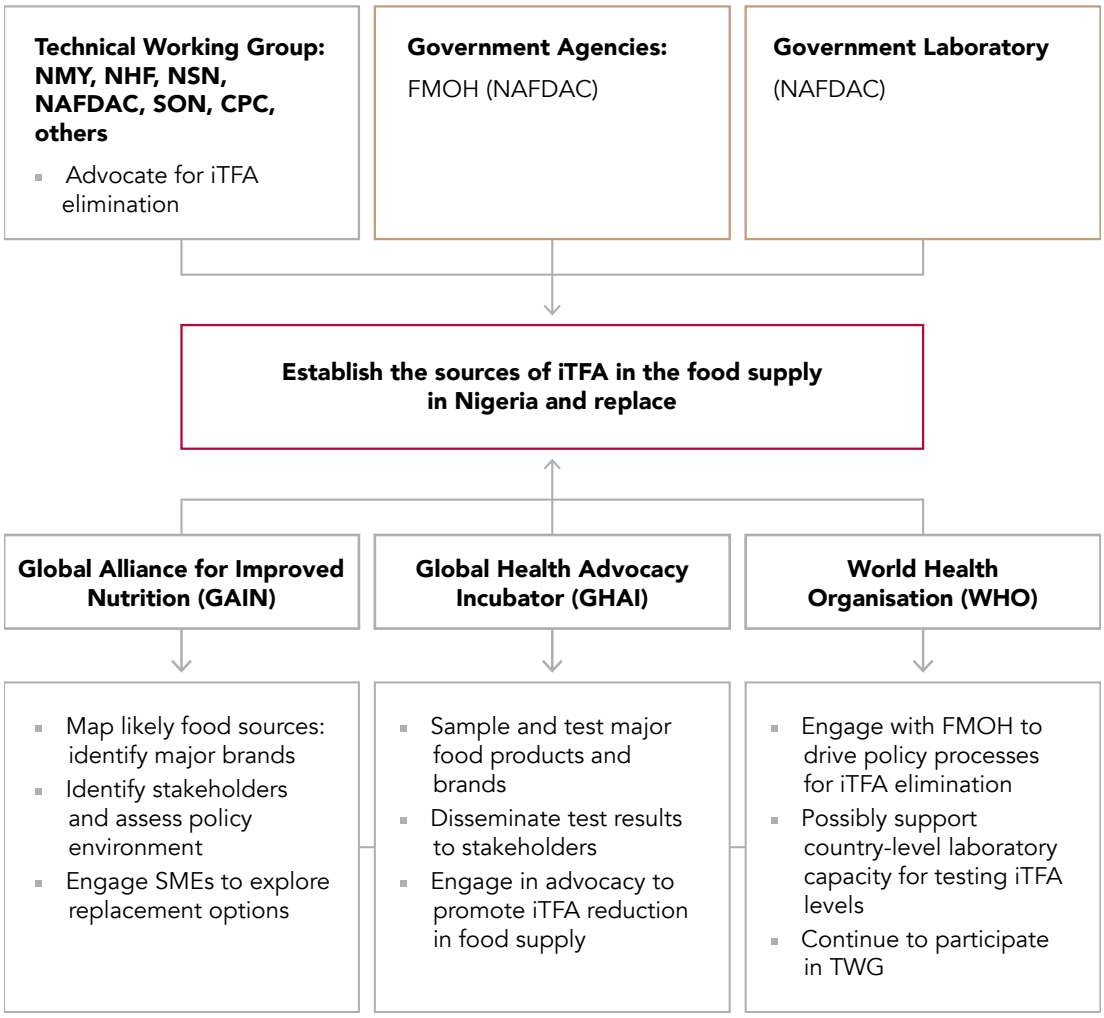
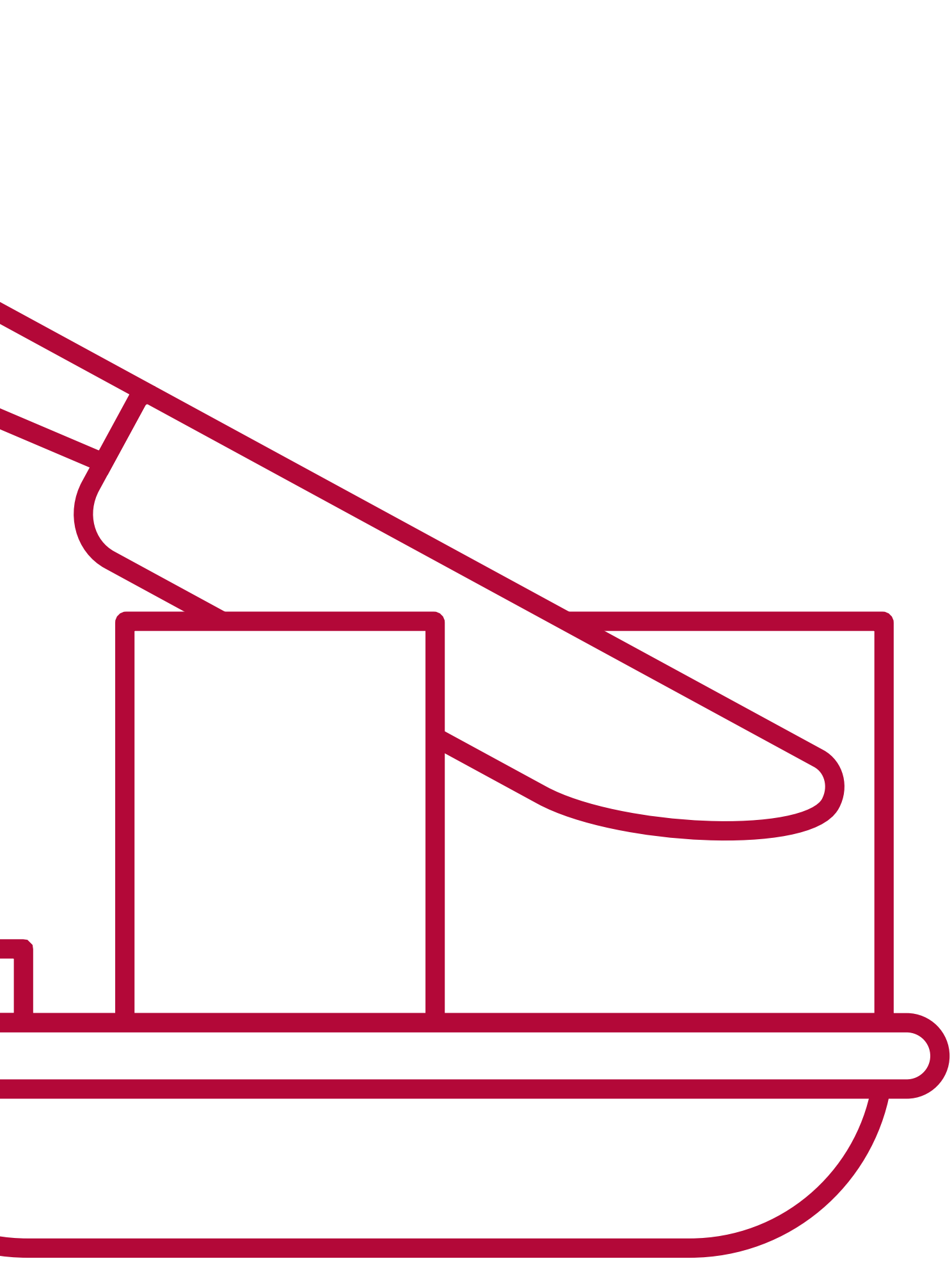


Figure 13: Current/planned activities and coordination of iTFA activities among stakeholders

Three organisations currently certify food products in Nigeria, these include the Nigerian Heart Foundation, the Nutrition Society of Nigeria and the Nigerian Institute of Food Science and Technology. The Nutrition Society of Nigeria endorsement relates to specific nutrient content or nutrient content claims in food products. Endorsement has a lifespan of one year within which the manufacturers need to apply for recertification. Samples are received and analysed both within and outside Nigeria. The Nutrition Society of Nigeria has a scientific committee that handles product endorsement. The Nigerian Heart Foundation provides endorsement for products such as vegetable oil, dairy products and water. The Nigerian Heart Foundation endorsement for vegetable oil is based on cholesterol content, fatty acid content (saturated fats, polyunsaturated and monounsaturated fats), potassium, and sodium content, as well as vitamin A fortification. The Nigerian Heart Foundation does not assess the iTFA levels in vegetable oil but recently started receiving iTFA content information from product manufacturers. Products currently certified include Power Oil, Mamdor, Grandis, and Lahda. Based on the existing laboratory capacities of NAFDAC, the current certification procedure requires manufacturers to first approach NAFDAC which will request that certain tests are carried out on the products being presented for certification. Following the initial tests conducted by manufacturers, the Nigerian Heart Foundation then conducts an independent analysis of the specific elements being certified. If the results are within acceptable limits, the Nigerian Heart Foundation provides the relevant endorsement and the manufacturer is allowed to use the licence for one year.

4



4. Replacement options for iTFA

There are several alternatives and replacement solutions to iTFA.[88] These alternatives include naturally stable oils such as cotton seed, corn, palm, peanut, and rice bran, as well as modified fatty acid oils such as mid-oleic corn, high-oleic sunflower, low-linoleic canola, high-oleic sunflower, mid-oleic sunflower, low-linolenic soybean, and mid-oleic/low-linolenic soybean oils.[89] Food manufacturers are using or developing four technological options to replace iTFA in their products. These options include:

- Modification of the hydrogenation process
- The use of inter-esterification
- Use of fractions high in solids from natural oils
- Use of trait- enhanced oils

4.1 Modified hydrogenation/ modification of the hydrogenation Process

Hydrogenation is a common technique to provide firmness and plasticity to shortenings, thus, enabling the production of solid and semi-solid fats. The standard hydrogenation process can be modified by increasing the pressure, decreasing the temperature or changing the catalyst (or the concentration of the catalyst) to lower the levels of iTFA of the resulting oil.[90] Modification option offers the possibilities to selectively reduce the number of iTFA produced during hydrogenation. Up to 80% of iTFA replacement has been achieved in some modified hydrogenation process.[91] Nevertheless, a major drawback to the adoption of a modified hydrogenation process is that extremely high pressure and concentrations of catalysts required can reduce commercial viability.

It is possible to make equivalently performing low-trans fats by increasing the degree of hydrogenation, which reduces the level of iTFA but increases the level of SFA. Full hydrogenation of vegetable oils would produce exclusively SFAs that are too waxy and solid to use in food production. Modification of the hydrogenation process can be used to prepare low-trans baking shortenings. Low or zero-trans baking fats may have increased levels of stearic acid from the hydrogenation of α-linolenic, linoleic, and oleic acids, and also significant levels of palmitic acid for functionality. Overall, the hydrogenation approach would be expensive on a commercial scale.

Modified Hydrogenation	Difficult implementation
▪ Technical feasibility: The availability of this technology to small scale processors in Nigeria is yet to be determined - Currently it does not appear that hydrogenation of oil is widely practiced in Nigeria ▪ Full hydrogenation of vegetable oils would produce exclusively saturated fatty acids that are too waxy and solid to use in food production ▪ Extremely high pressure and concentrations of catalysts required can reduce commercial viability	
Cost	**High cost**
▪ This hydrogenation approach would be expensive on a commerical scale	
Health consideration	**Moderate health benefits**
▪ High in saturated fatty acids (SFA)	

88 Tarrago-Trani, Phillips, Lemar, & Holden, 2006.
89 Eckel et al., 2007
90 Eller, List, Teel, Steidley, & Adlof, 2005; King, Holliday, List, & Snyder, 2001; Wright, Wong, & Diosady, 2003.
91 Eckel et al., 2007

4.2 The use of inter-esterification

Inter-esterification is a process to rearrange or redistribute the fatty acids either through the use of chemical or enzymatic catalysts within and between the triglycerides. Interesterification of vegetable oils is currently a widely adopted modification technique for hardening triglycerides contained in unsaturated vegetable oils.[92] Interesterification is a chemical reaction that redistributes fatty acids on the glycerol backbone of a triglyceride molecule by blending fatty acids from more than one type of triglyceride. The process does not change the fatty acid composition or the degree of unsaturation but does alter the triacylglycerol composition, thus affecting the melting profile and crystal habit of a fat. Although in the past both random and directed interesterification techniques have been used as fat modification tools, more recently the use of enzymes for the modification of food oils has attracted the attention of researchers.[93]

Inter-esterification modifies the melting and crystallization behaviour of the fat, thus producing fats with the desirable physical properties of trans fats but without iTFA. One current application of this process is in the production of trans-free or low trans fat spreads, margarine, and shortening. In practical terms, a liquid and a hard stock such as PKO, and solid palm fraction are blended and inter-esterified. The benefit of inter-esterification is that it does not change the degree of unsaturation of the fatty acids, and it does not convert cis into trans isomers. If an enzymatic catalyst is used, the resulting inter-esterification process is continuous and specific, with steeper solid fat curves to provide better functionality without the need for extensive post processing.[94]

The inter-esterification approach using natural fatty acids as hardening ingredients is costly. The high cost of the enzymatic catalyst may limit the adoption of inter-esterification. Additionally, more research is needed to fully assess the health impact of inter-esterified oil. Inter-esterified oils and fully hydrogenated oils should carry ingredient declaration that is acceptable to the consumer market.

Inter-esterification	**Moderate implementation difficulty**
▪ Technical feasibility: widely adopted modification technique for hardening triglycerides contained in unsaturated vegetable oils	
Cost	**High cost**
▪ The inter-esterification approach using natural fatty acids as hardening ingredients is costly ▪ The high cost of the enzymatic catalyst may limit the adoption of inter-esterification	
Health consideration	**Moderate health benefits**
▪ The health implications of these oils are still being studied ▪ The benefit of inter-esterification is that it does not change the degree of unsaturation of the fatty acids, and it does not convert cis into trans isomers	

92 Idris & Dian, 2005
93 Xu et al., 2006
94 Eckel et al., 2007

4.3 Fractionation and blending/use of fractions high in solids from natural oils

Tropical oils obtained from plants in the tropics such as palm oil, PKO and coconut oil can also be alternatives to replace iTFA in the food supply chain. These types of oils have the advantages of functionality, economics, availability, and familiarity by most users.[95] Fractions high in solids and derived from natural oils (coconut, palm oil, and PKO) are not new to the food industry and have been components of functional ingredients for years. If fat is melted and cooled slowly to below its melting point, the triglycerides with a higher melting point than the tempering temperature will eventually form crystalline material, which is relatively easy to centrifuge or filter off from the liquid part. Many commercially available fractions come from palm oil and PKO. They can be used successfully either as single fractions or in combination with other fractions to meet specific needs.

Fractionation involves controlled crystallization of vegetable oil, followed by a separation of the crystals from the partially crystallized mass. The fat is consequently divided into two parts, namely: the hard fraction called stearin and the soft or fluid fraction called olein. Three main commercial processes for fractionating palm oil are in use: the fast-dry process, the slow-dry process and the detergent process. All these processes lead to specific products of different quality with different yield and operating costs. Dry fractionation is by far the simplest and cheapest fractional crystallization technique (no chemicals, no effluent and no losses). Palm oil provides a reasonable alternative for the mainly hydrogenated shortening, in which the crystalline, solid form exists naturally. Also, palm oil provides a cheap, natural solid alternative to the shortening that is commonly used in bakery products because of its plasticity and solid/liquid ratio.

This fractionation approach is costly and involves much testing to create optimal combinations of natural ingredients. Palm oil fractions and palm oil blends as well as coconut oil, are popular due to their solid state at room temperature, but formulators must assure that: "Partially Hydrogenated Oil (PHO) replacement should, as a minimum, contain less saturated fatty acids than the sum of saturated fatty acids and trans fatty acids in the currently used PHO products. Saturated fatty acids should be as low as possible, and polyunsaturated fatty acids should be as high as possible", as recommended by WHO.

Fractionation and blending (dry fractionation)	Low implementation difficulty
▪ Technical feasibility: Simple technique Raw materials like palm oil are widely available in Nigeria and current fractions of Olein and Stearin produced by local manufacturers	
Cost	**Moderate cost**
▪ Cheapest fractional crystallisation technique (no chemicals, no effluent and no losses) ▪ This fractionation approach is costly and involves much testing to create optimal combinations of natural ingredients ▪ Palm oil provides cheap, natural solid alternative to the shortening that is commonly used in bakery products. Palm oil fractions and palm oil blends as well as coconut oil are popular due to their solid state at room temperature	
Health consideration	**Moderate health benefits**
▪ Formulators must assure that the resulting saturated fat on the label is acceptable from the company and consumer viewpoint	

95 Eckel et al., 2007

4.4 Use of trait-enhanced oil

Trait-enhanced oils are new oilseed varieties that can yield stable oils that do not require hydrogenation.[96] There are three broad categories of trait enhanced oil: high-oleic acid oils, such as high-oleic soybean, sunflower and canola oils,[97] mid-range oleic acid oils, such as mid-oleic sunflower and soybean oils, and low-linolenic acid oils, such as low-linolenic canola and soybean oils. The term "low linolenic" commonly refers to oil containing about 1–3% α-linolenic acid. Soybean oil typically contains about 7%, and canola oil, about 10% α-linolenic acid. Trait enhanced oils are developed through conventional plant breeding or biotechnological methods.[98] All of these trait-enhanced oils have acceptable functionality (such as good oxidative stability) for frying, spraying, and some bakery applications. High cost, limited availability and limited application may hinder the use of trait-enhanced oils.[99] Consumers of trait modified oils will need to obtain essential dietary unsaturated fatty acids from other sources. Trait modified oils are considered heart-healthy and do not contain cholesterol. However, higher costs associated with grower premiums will not make this attractive in the food manufacturing industry.[100]

These modification techniques offer the chance to minimise and control the iTFA content of oil blends and can be used to formulate trans-free hardstocks. However, the combination of these techniques leads to a greater variety of hardstocks with a wider range of physical properties such as solid fat phase and melting point behaviour.

Recent trends have indicated that the fast-food industry has replaced many frying fats by medium- and high-stability vegetable oils, resulting in a virtual elimination of iTFA in products fried in these fats and a significant reduction of saturated fats as well (usually by more than 50%). Table 6 below presents detailed examples of the above technical solutions.

Use of trait-enhanced oils	**Moderate implementation difficulty**
▪ Technical feasibility: trait enchanced oils are developed through conventional plant breeding or biotechnological methods ▪ Trait- enhanced oils have acceptable functionality (such as good oxidative stability) for frying, spraying, and some bakery applications	
Cost	**High cost**
▪ High cost and limited availability may hinder the use of trait- enhanced oils	
Health consideration	**Moderate health benefits**
▪ Consumers of trait modified oils will need to obtain essential dietary unsaturated fatty acids from other sources ▪ Trait- enhanced oils are more saturated than natural oils ▪ Virtually free of trans fats	

96 Eckel et al., 2007
97 Eckel et al., 2007; Skeaff, 2009
98 Eckel et al., 2007; Serrano-Vega, Martínez-Force, & Garcés, 2005; Skeaff, 2009
99 Eckel et al., 2007
100 Krawczyk, 1999

Table 6: Available technical solutions for iTFA replacement. Adapted from Health Canada (2006).

Food Manufacturing Applications	Alternatives/ Available Technical solutions	Comment Type of Oil / Examples
Frying fats	Stable Plant Oils/ Medium- and high-stability vegetable oils	High oleic canola oil High oleic sunflower oil Low linolenic soya oil
Consumer and food Service margarine (soft)	Inter-esterified oils with Vegetable oil	Mid oleic sunflower oil Palm and palm kernel stearin, with canola Oils
Consumer and food Service margarine (hard)	Inter-esterified oils with Vegetable oil	Palm and PK stearin, with soya oils Fully hydrogenated vegetable oils and liquid Vegetable oils
Baking margarine (soft)	Inter-esterified oils with vegetable oil	Palm and PK stearin, with soya oils
Baking Margarine (hard and laminating)	Blending of soft oils and highly saturated oils The blending of soft oils and highly saturated oils Interesterified oils with vegetable oil	Palm oil or palm stearin and general vegetable oils Palm and Palm Kernels Palm oil or Palm Stearin and high-Stability vegetable oils Palm and Palm Kernel Stearin with soya oils
Bakery or food processor Shortening (Spray/liquid)	General vegetable oils Medium and high stability Vegetable oils	High Oleic-Canola oil High Oleic-Canola oil
Bakery or food processor shortening(solid)	Blending oils for solids and performance. Interesterified oils with vegetable oil	Palm oil or palm stearin or fully hydrogenated oil and medium stability vegetable oils Palm and palm kernel stearin with canola oil Palm and Palm Kernel Stearin with high oleic canola oil

4.5 Additional alternatives to partially hydrogenated oils

Other alternatives to partially hydrogenated fats include naturally stable non-tropical oils which are naturally low in linolenic acid content such as corn oil and cottonseed oil. The functionality of these alternative makes them feasible as replacement options. However, the availability of these alternatives may be limited in a country like Nigeria. Corn is used for food, feed, starch and alternative fuel, and its use as oil in Nigeria is rare. Cottonseed oil is also high in saturated fats, and its availability may be a challenge.[101]

Other options include:

- Adding antioxidants (for example, a concentrate of natural mixed tocopherols) to affordable oils such as soy or sunflower will increase the cost but can increase the fry life of the oil and the shelf life of the end product. With the additional benefit of high omega-3 and omega-6 PUFA, this would be the healthier option. However, even with antioxidants, fry life and shelf life will be shorter than for stable oils such as high oleic oils. The requirement to declare additives, such as added antioxidants, depends on local legislation and must be carefully evaluated to ensure legal compliance of products sold.
- Addition of emulsifiers and surfactants (for example, lecithin, monoglycerides, polysorbate) to all oil variants mentioned can reduce spattering during frying. It can also improve dough handling and end products in baking bread and cake.
- Return to butter/animal fat is an option for replacing iTFA as these substances are very low in trans fat. However, these substances are high in saturated fat and cholesterol and extremely atherogenic.[102] Therefore iTFA replacement by butter/animal fats is not viable because of the adverse metabolic effects of this type of lipid.

Other alternatives to partially hydrogenated fats include naturally stable non-tropical oils which are naturally low in linolenic acid content such as corn oil and cottonseed oil.

101 Eckel et al., 2007
102 Constant, 2004

4.6 Considerations for the adoption of iTFA replacement options

Several factors, including performance, availability, economics, and safety, must be considered when introducing alternatives to iTFA in the market. iTFA replacement options must be able to provide at least the same functional characteristics of the materials they replace. Product reformulation that requires the removal of TFAs from food may result in increased levels of SFA. Efforts to replace PHVOs in emerging markets require close monitoring to ensure that palm oil is not used exclusively as a replacement option due to high levels of SFA in palm oil[103] and potential environmental damage. The recommended consumption of SFA should be less than 7% of the total energy intake.[104]

It is possible to replace iTFA and SFA with oil rich in PUFA and MUFA. However, the optimal amount of PUFA or MUFA that can be used to replace iTFA and SFA is yet to be defined. Important factors to consider in iTFA replacement include the following:

- Performance of substitutes should mimic PHO as much as possible to minimise local investments, reformulation time and research and development efforts, especially for local MSMEs.
- A reliable, large supply of oils and hardstocks is required to support food manufacturing.
- The cost of any substitute should preferably be the same as, or minimally greater than, currently used PHO. Vegetable oil prices are volatile and depend on production and demand.[105]
- PHO replacements should, as a minimum, contain less SFA than the sum of SFA and iTFA in the currently used PHO products. SFA should be as low as possible, and PUFA should be as high as possible, and should preferably include both omega-6 and omega-3.

Palm kernel oil and palm oil[106] are the predominant raw materials refined into edible oils in Nigeria. The choice of alternative oils in iTFA replacement should be made according to:

- Public health interest.
- The intended use of the oil which should be considered especially the functionality desired with regards to the sensory properties.
- The availability of raw materials which may tend to vary within the country. There may be an abundance of palm oil and palm kernel oil in the south east and south west of Nigeria compared to the northern zones. Similarly, soya beans and groundnuts may be more abundant in the north.
- The cost of the replacement alternative.
- The impact on the company's branding, a company with a brand of soya oil cannot suddenly make a switch to palm olein without advertisement consequences.

103 Kennedy, Martinez, Chuang, LaPoint, & McIntosh, 2008; Kris-Etherton, Innis, & Ammerican, 2007

104 Kris-Etherton et al., 2007

105 Historical data from the United States (AOCS lipid library, 2001–2011) show that palm oil was often 15–35% cheaper than soy oil, which is generally the cheapest liquid oil.

106 The domestic production of palm oil in Nigeria is estimated to be 133,000 tonnes, along with the additional import of 32,000 tonnes. Persistence Market Research, 2018 in WHO, 2019.

Nigeria case study: Possible replacement options for PHO in biscuits manufacturing

This report estimated that the biscuits value chain is one of the food products with the highest iTFA content in Nigeria. Pending results of laboratory analysis of biscuits samples, this section presents some background on the possible replacement options for PHO in the biscuit value chain in Nigeria.

In biscuits, fat – called shortening - is one of the main ingredients besides flour and sugar. In biscuit production the level and type of fat relates to the homogeneous distribution in the dough and possibly the aeration of the dough, final dough hardness before cutting, spread in the oven, hardness of the biscuit, eating quality, texture and flavor as well as shelf life of the biscuit. Fats and oil modification techniques have been developed to obtain the various characteristics needed. One of the major modification techniques developed is hardening/ hydrogenation.

Fat is a principle ingredient responsible for the tenderness of biscuit, and it keeps its quality, grain and texture (O'Brien, Chapman, Neville, Keogh, & Arendt, 2003). Fats act as a lubricant during mixing; they also prevent the formation of a gluten network in the dough (Wade, 1988). Fat interacts with other ingredients to develop and mold texture, mouthfeel, and the overall sensation of lubricity of the product (Giese, 1996; Stauffer, 2005).

The challenges of replacing hydrogenated shortening in baked products include a reduction in shelf life, and changes in texture (such as loss of softness, and crispness). Other changes include flavor differences and functional differences such as loss of volume, appearance change, and the development of a greasy or oily character. There are also challenges in finding iTFA–free alternative shortenings without increasing SFA content. Many companies that made a switch to iTFA–free alternatives for their baked goods chose shortenings made with palm oil or butter (Eckel et al., 2007).

Palm oil has become one of the leading vegetable oils for applications in biscuit production because it has a balanced fatty acid composition in which the level of saturated fatty acids is almost equal to that of the unsaturated fatty acids and for this reason, palm oil can readily be fractionated. Based on information elicited from stakeholders' there are indications that the fraction of palm oil (palm stearin) is used in the production of biscuits in Nigeria. As iTFA are phased out, food companies may turn to mono- and diglycerides as low-cost alternatives. This alternative appears to be currently used by some biscuit companies in Nigeria.

Nigeria case study: Research in Nigeria on the blending of vegetable oils

One of the options for iTFA replacement is to blend oils that are rich in antioxidants with common vegetable oils that generally need hydrogenation for stability. Example of this was demonstrated by Iranloye and Fapojuwo, 2019 who blended moringa Oil, which is very rich in antioxidants, with soybean Oil, which is usually partially hydrogenated for stability. The work showed that the antioxidant present in the moringa oil in a 70:30 blend of soybean oil and moringa oil, was sufficient to stabilise the soybean oil without the need for hydrogenation. Therefore, it might be worth identifying oil seeds, especially the underutilised ones that may be rich in antioxidants as potential replacement solutions through blending.

This replacement option will call for the development of a blend that could be made available to companies as one of their raw materials. Depending on which oils to blend, the companies may buy the appropriate oils and mix them as necessary. In other words, if the individual oils are available in the market, the company may purchase them individually and mix them in the right proportions, thus making hydrogenation unnecessary. This option calls for research into vegetable oils that can be blended and in what ratio to avoid hydrogenation.

Conclusion

Based on the interviews conducted for this report, biscuits and margarines are estimated to be among the main sources of iTFA in Nigeria. Secondary estimated iTFA sources include baked products such as bread, cakes and other confectionery. Assessing the level of iTFA in Nigerian food is urgently needed to build support for policy action and to establish a baseline for measuring progress over time. It is important to develop laboratory capacity in the country to carry out necessary tests. Engaging in activities that will lead to the generation of iTFA data and harmonisation of stakeholders' activities to achieve this is therefore recommended by stakeholders as the most important action for the effective take-off of iTFA replacement in Nigeria.

Recommendations

- Regulations should be adopted and implemented to limit iTFA levels to no more than 2 grams per 100grams of oils and fats. The regulations should include measures to address iTFA content in the informal sector (notably oil producers) and be accompanied by sufficient laboratory capacity to conduct the necessary testing. This will generate both incentives and a fair playing field for the private sector in Nigeria on iTFA replacement.
- Regulations on iTFA replacement should take into account the capacity and time needed by local companies to achieve a limit of 2 grams of iTFA per 100 grams of oils and fats, especially for SMEs.
- Regulations on iTFA replacement should require food business operators supplying food to other food business operators to provide them with the information on the amount of trans fat, other than trans fat naturally occurring in fat of animal origin, where that amount exceeds 2 grams per 100 grams of fat. Recognising the limited capacity of SMEs to assess iTFA levels themselves among the ingredients they purchase.
- Business should be involved in the NCD Strategy Nigeria 2019-2025, especially around the expected role in the implementation of the iTFA related part of the Strategy.
- Public sector's consumer awareness campaigns around the negative health impact of iTFA and the benefit of trans fat free products would support demand creation of trans fat free products and incentivise/reward companies investing in the production of trans fat free products.

References

Akinroye, K. K., Olukosi, Y. A., Atinmo, T., Omueti, O., Babasola, C. F., Idigbe, O., … Nasidi, A. (2017). Consensus Summit: Lipids and Cardiovascular Health in the Nigerian Population. European Journal of Nutrition & Food Safety, 109–119.

Ayanwale, A. B., Fatunbi, A. O., & Ojo, M. P. (2018). Baseline Analysis of Plantain (Musa sp.) Value Chain in Southwest of Nigeria. FARA Research Report.

Baltsavias, A., Jurgens, A., & Van Vliet, T. (1999). Fracture properties of short-dough biscuits: Effect of composition. Journal of Cereal Science, 29(3), 235–244.

Bhardwaj, S., Passi, S. J., Misra, A., Pant, K. K., Anwar, K., Pandey, R. M., & Kardam, V. (2016). Effect of heating/reheating of fats/oils, as used by Asian Indians, on trans fatty acid formation. Food Chemistry, 212, 663–670.

Constant, J. (2004). The role of eggs, margarines and fish oils in the nutritional management of coronary artery disease and strokes. The Keio Journal of Medicine, 53(3), 131–136.

Dhaka, V., Gulia, N., Ahlawat, K. S., & Khatkar, B. S. (2011). Trans fats—Sources, health risks and alternative approach-A review. Journal of Food Science and Technology, 48(5), 534–541.

Downs, S. M., Thow, A. M., & Leeder, S. R. (2013). The effectiveness of policies for reducing dietary trans fat: A systematic review of the evidence. Bulletin of the World Health Organisation, 91, 262–269h.

Eckel, R. H., Borra, S., Lichtenstein, A. H., & Yin-Piazza, S. Y. (2007). Understanding the Complexity of Trans Fatty Acid Reduction in the American Diet: American Heart Association Trans Fat Conference 2006: Report of the Trans Fat Conference Planning Group. Circulation, 115(16), 2231–2246. https://doi.org/10.1161/CIRCULATIONAHA.106.181947

Eller, F. J., List, G. R., Teel, J. A., Steidley, K. R., & Adlof, R. O. (2005). Preparation of spread oils meeting US food and drug administration labeling requirements for trans fatty acids via pressure-controlled hydrogenation. Journal of Agricultural and Food Chemistry, 53(15), 5982–5984.

Fattore, E., Bosetti, C., Brighenti, F., Agostoni, C., & Fattore, G. (2014). Palm oil and blood lipid–related markers of cardiovascular disease: A systematic review and meta-analysis of dietary intervention trials. The American Journal of Clinical Nutrition, 99(6), 1331–1350.

Giese, J. (1996). Fats and fat replacers: Balancing the health benefits. Food Technology (USA).

Gotoh, N., Kagiono, S., Yoshinaga, K., Mizobe, H., Nagai, T., Yoshida, A., … Nagao, K. (2018). Study of trans fatty acid formation in oil by heating using model compounds. Journal of Oleo Science, ess17209.

Idris, N. A., & Dian, N. L. H. M. (2005). Interesterified palm products as alternatives to hydrogenation. Asia Pacific Journal of Clinical Nutrition, 14(4), 396.

Israel, M. O. (2015). Shea Butter: An Opposite Replacement for Trans Fat in Margarine. Journal of Nutrition & Food Sciences, (S11), 1.

Kennedy, A., Martinez, K., Chuang, C.-C., LaPoint, K., & McIntosh, M. (2008). Saturated fatty acid-mediated inflammation and insulin resistance in adipose tissue: Mechanisms of action and implications. The Journal of Nutrition, 139(1), 1–4.

King, J. W., Holliday, R. L., List, G. R., & Snyder, J. M. (2001). Hydrogenation of vegetable oils using mixtures of supercritical carbon dioxide and hydrogen. Journal of the American Oil Chemists' Society, 78(2), 107–113.

Koh-Banerjee, P., Chu, N.-F., Spiegelman, D., Rosner, B., Colditz, G., Willett, W., & Rimm, E. (2003). Prospective study of the association of changes in dietary intake, physical activity, alcohol consumption, and smoking with 9-y gain in waist circumference among 16 587 US men. The American Journal of Clinical Nutrition, 78(4), 719–727.

Kris-Etherton, P. M., Innis, S., & Ammerican, A. D. (2007). Position of the American Dietetic Association and Dietitians of Canada: Dietary fatty acids. Journal of the American Dietetic Association, 107(9), 1599–1611.

Lamarche, B., & Couture, P. (2015). Dietary fatty acids, dietary patterns, and lipoprotein metabolism. Current Opinion in Lipidology, 26(1), 42–47.

Lopez-Garcia, E., Schulze, M. B., Meigs, J. B., Manson, J. E., Rifai, N., Stampfer, M. J., … Hu, F. B. (2005). Consumption of trans fatty acids is related to plasma biomarkers of inflammation and endothelial dysfunction. The Journal of Nutrition, 135(3), 562–566.

Micha, R., & Mozaffarian, D. (2009). Trans fatty acids: Effects on metabolic syndrome, heart disease and diabetes. Nature Reviews Endocrinology, 5(6), 335.

Mozaffarian, D. (2015). Natural trans fat, dairy fat, partially hydrogenated oils, and cardiometabolic health: The Ludwigshafen Risk and Cardiovascular Health Study. Oxford University Press.

Mozaffarian, D., Katan, M. B., Ascherio, A., Stampfer, M. J., & Willett, W. C. (2006). Trans fatty acids and cardiovascular disease. New England Journal of Medicine, 354(15), 1601–1613.

Mozaffarian, D., & Stampfer, M. J. (2010). Removing industrial trans fat from foods. British Medical Journal Publishing Group.

Nishida, C., & Uauy, R. (2009). WHO Scientific Update on health consequences of trans fatty acids: Introduction. European Journal of Clinical Nutrition, 63(S2), S1–S4. https://doi.org/10.1038/ejcn.2009.13

O'Brien, C. M., Chapman, D., Neville, D. P., Keogh, M. K., & Arendt, E. K. (2003). Effect of varying the microencapsulation process on the functionality of hydrogenated vegetable fat in shortdough biscuits. Food Research International, 36(3), 215–221.

Okpuzor, J., Okochi, V. I., Ogbunugafor, H. A., Ogbonnia, S., Fagbayi, T., & Obidiegwu, C. (2009). Estimation of cholesterol level in different brands of vegetable oils. Pakistan Journal of Nutrition, 8(1), 57–62.

Sanders, T. A. B. (2009). Fat and fatty acid intake and metabolic effects in the human body. Annals of Nutrition & Metabolism, 55(1–3), 162.

Serrano-Vega, M. J., Martínez-Force, E., & Garcés, R. (2005). Lipid characterization of seed oils from high-palmitic, low-palmitoleic, and very high-stearic acid sunflower lines. Lipids, 40(4), 369–374.

Siri-Tarino, P. W., Sun, Q., Hu, F. B., & Krauss, R. M. (2010). Meta-analysis of prospective cohort studies evaluating the association of saturated fat with cardiovascular disease. The American Journal of Clinical Nutrition, 91(3), 535–546.

Skeaff, C M. (2009). Feasibility of recommending certain replacement or alternative fats. European Journal of Clinical Nutrition, 63(S2), S34–S49. https://doi.org/10.1038/sj.ejcn.1602974

Skeaff, C. Murray, & Miller, J. (2009). Dietary fat and coronary heart disease: Summary of evidence from prospective cohort and randomised controlled trials. Annals of Nutrition & Metabolism, 55(1–3), 173.

Stauffer, C. E. (2005). Fats and oils in bakery products. Bailey's Industrial Oil and Fat Products.

Tarrago-Trani, M. T., Phillips, K. M., Lemar, L. E., & Holden, J. M. (2006). New and existing oils and fats used in products with reduced trans-fatty acid content. Journal of the American Dietetic Association, 106(6), 867–880.

Teegala, S. M., Willett, W. C., & Mozaffarian, D. (2009). Consumption and health effects of trans fatty acids: A review. Journal of AOAC International, 92(5), 1250–1257.

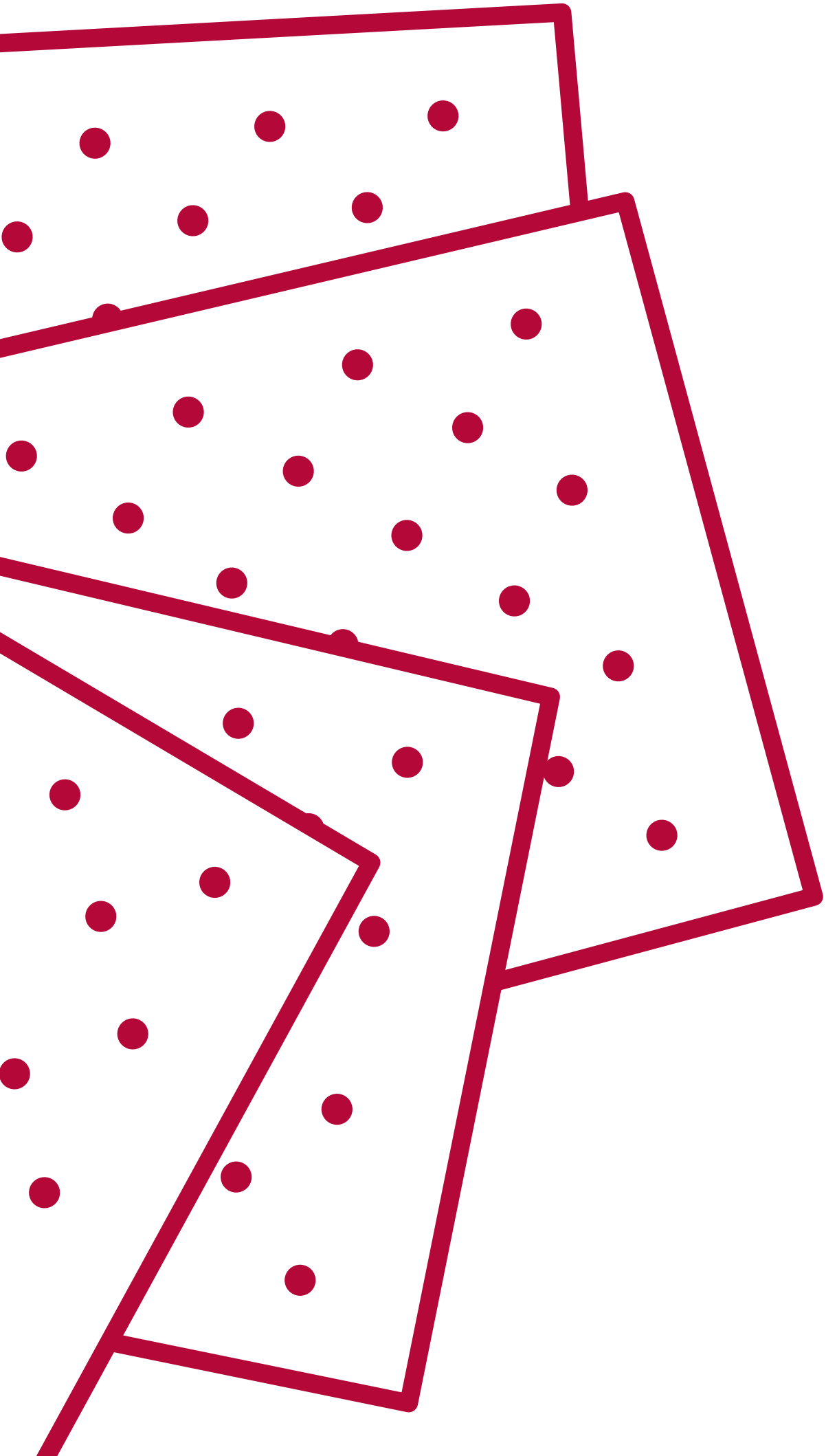
Wang, F. C., Gravelle, A. J., Blake, A. I., & Marangoni, A. G. (2016). Novel trans fat replacement strategies. Current Opinion in Food Science, 7, 27–34.

Wim De Greyt, R&D Manager, Desmet Ballestra, Zaventem, Belgium, "Deodorization", AOCS Lipid Library.

Wright, A. J., Wong, A., & Diosady, L. L. (2003). Ni catalyst promotion of a Cis-selective Pd catalyst for canola oil hydrogenation. Food Research International, 36(9–10), 1069–1072.

Zetzl, A. K., & Marangoni, A. G. (2014). Structured emulsions and edible oleogels as solutions to trans fat. In Trans Fats replacement solutions (pp. 215–243). Elsevier.

ANNEX

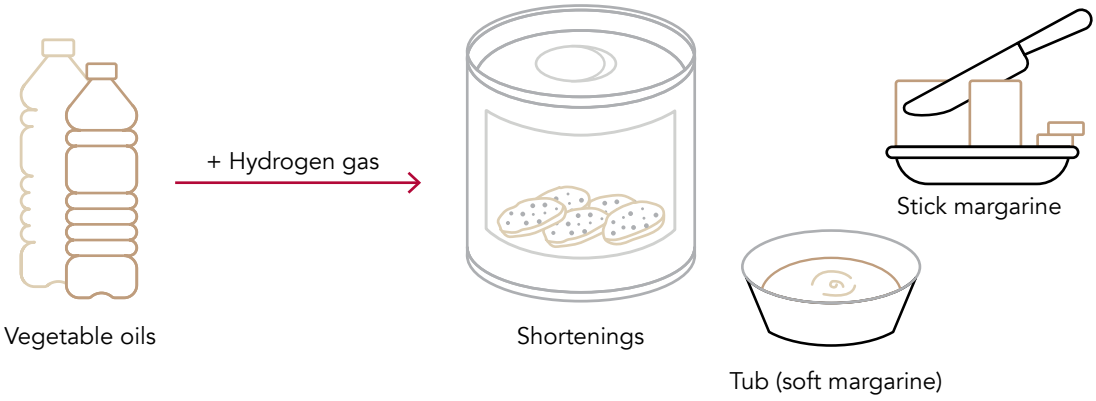


ANNEX

Annex 1 - Industrial trans fat key informant interview guide

This interview guide is intended to be used to collect information to support the replacement of industrial trans fat by Small and Medium Enterprises. The information is collected for the Global Alliance for Improved Nutrition leading a pilot project for industrial trans fat in Nigeria in Pakistan between 2019 and 2020.

For any queries about the project please contact laubert@gainhealth.org



Industrial trans fat, definition

Industrial trans fat are unhealthy fats that are produced when vegetable oils are heated or when they are "hydrogenated".

Hydrogenation is the process of bubbling hydrogen gas through the oil to harden/make solid the oil. Stopping the hydrogenation part of the way through the process results in a partially hydrogenated oil, a product with a butter-like consistency but much cheaper to produce than butter.

Partially hydrogenated oils have been used by food manufacturers to improve the food texture, food flavour stability, and keep some foods fresh for a long time. It is sold as 'margarine', 'oleo' or 'vegetable shortening'. Partially hydrogenated oils are the main source of industrial trans fat.

Industrial trans fat, the negative health impact

Industrial trans fat are now known for increasing risks of health problems such as:

- coronary heart disease
- cancer
- diabetes
- obesity
- liver dysfunction
- infertility

The World Health Organisation estimates that industrial trans fats cause more than 500 000 deaths from coronary heart disease every year globally. It is recommended to avoid foods made with partially hydrogenated oils (such as hard butter and margarine), as they contain high levels of industrial trans fat.

Industrial trans fat, the regulations

Progress in removing industrial trans fat has been strongest in North America and Europe. In Denmark for example, virtual elimination of industrial trans fat has been achieved. However, much more progress is still required globally. The 2018 Access to Nutrition Index reports that only 20% of 193 countries have policies in place to address saturated fat and trans fat.

There are no current industrial trans fat regulations in Nigeria and in Pakistan the first national trans fat limit inclusion adopted in 2017 (10% limit – Standard specifications for Vanaspati).

Increased regulations are expected at national level across the globe, companies have an opportunity to be ahead of the competition by replacing industrial trans fat before the adoption of these regulations.

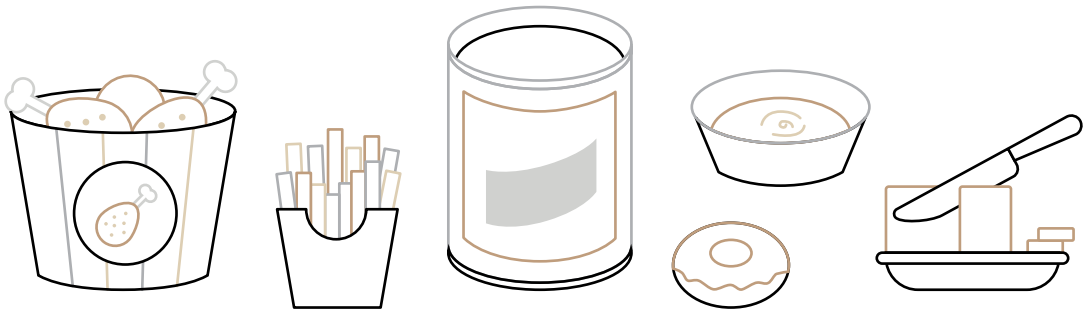
Industrial trans fat, the solutions

Industrial trans fat can be reduced or eliminated, and alternative fats and oils for food production exist. Replacing industrial trans fat from the food supply with alternative sources of fat has positive health effects, such as reducing the risk of coronary heart disease.

The main industrial trans fat replacement solutions are:

- Fully hydrogenated fats as a source of saturated fat or hard fat for formulation and or interesterification
- Trait – enhanced oils with high oleic and saturated fatty acids
- Stable liquid oils
- Liquid oils with antioxidants
- Liquid oil with texturisers (emulsifiers, encapsulation, structuring agents)
- Liquid oils blended with 'hardstock'
- Interesterified fats
- Tropical oils
- Fractionated fats
- Structured fats or designer fats

Foods with industrial trans fat in Nigeria



Food with industrial trans fat in Nigeria			
Fast food	**Supermarket products**	**Fats and oils**	**Bakery products**
▪ Baked goods (biscuits, cookies, and pastries) ▪ Fried foods (French fries, and doughnuts) ▪ Deep-fried fast food (akara, fried chicken)	▪ Ready-to-microwave popcorn ▪ Biscuits ▪ Wafers ▪ Crackers ▪ Baked goods	▪ Shortening ▪ Partially hydrogenated oils ▪ Some margarines (notably of an industrial nature)	▪ Doughnuts ▪ Biscuits ▪ Cookies ▪ Pastries ▪ Cakes

1) Question for all

Do you know what industrial trans fat is?

If the answer is negative provide a brief introduction of industrial trans fat definition and types of products containing trans fat in the country.

2) Questions for food manufacturers

Core questions

What ingredients/raw materials do you commonly use in the manufacture of your products (probe for the specific product categories-oil, spread, etc.)?

What influence the choice of raw materials that you currently use?

Additional questions based on previous responses

What type of ingredients can you use as an alternative to the current ingredients you use?

Kindly describe the cost implications of the type of raw materials that you currently use and likely changes in price that may occur if you make a switch to other raw materials or ingredients.

What technical implications may arise if you change your raw materials or ingredient use? (probe for changes in the production line, packaging requirements, etc.)

Apart from your preferred replacement ingredients, what other replacement options exist for your product lines? (probe for any concerns such as cost or technical capacities or organoleptic properties of the product that may limit adoption of the available options).

Can you describe some of the processing conditions you employ in the manufacture of your products? (probe for processing temperature, pressure, time, availability of temperature or pressure control meters)

Can you describe how hydrogenation of oil is carried out in your organisation/factory? (probe for processing time, catalyst, temperature, types and proportion of oil, hydrogen pressure)

Do you have Standards Operating procedures for your product processing? (request to observe if conducting interviews within factory premises)

What is the installed capacity or your factory and what is the current operating capacity?

How do you think companies can be incentivised in replacing industrial trans fat?

3) Questions for out of home sector

Core questions

Can you describe the type of oil or baking margarine used in the processing of your food products?

Can you describe the type of products you get from your suppliers in this list: cakes, biscuits, snack foods, bakery products, margarines, vanaspati ghee, etc?

Are you willing to invest to provide healthier food for your consumers by replacing industrial trans fat?

Which proportion of your products is packaged with nutrition information? (if nutrition labelling existing, ask for information provided on fat/trans fat levels)

Additional questions based on previous responses

What capacities exist within your organisation to reformulate your product is there is a need to do so?

What may be the likely consequences of TFA reduction or elimination for your company?

If there were to be opportunities to support you to reduce or eliminate trans fatty acids from your products, what type of support will you like to receive (for own food preparation and for access to suppliers of products without industrial trans fat)?

If you need to reformulate your product raw materials and production processes what timeline will your organisation require to make the necessary changes? (probe for contributors to the duration specified, e.g., organisational processes or decision making, training and other factors)

Are you aware of the national recommendations on industrial trans fat in your country?

Are you familiar with the World Health Organisation recommendations on industrial trans fat?

4) Questions for companies that have replace industrial trans fat and for experts

What improved technologies are available for oil, shortening or margarine processing (probe for the feasibility to adopt available technology in the country context)

What are the current ways you think that small and medium-sized enterprises can be supported for industrial trans fat replacement? (probe for specific technical knowledge that may be required)

Do you have a laboratory within your company/ organisation to conduct industrial trans fat analysis? (probe for the availability of staff with the required technical capacity)

What measures are in place to encourage consumers to make healthier choices with regards to industrial trans fat?

How do you think companies can be incentivised in replacing industrial trans fat?

According to you, what policies and regulations (or related policies) for the replacement of industrial trans fat are likely to be adopted in the near/long term future?

What enforcement procedures are in place or will be needed to ensure the reduction or elimination of trans fats in Nigeria? Also, probe the conditions under which TFA claims are permitted on products.

What type of capacity building training on industrial trans fat replacements currently exist or could be provided to regulatory agencies staff in Nigeria?

Can you describe any regional or intercountry network that you are aware of that has/should have a role in promoting industrial trans fat replacement?

What research exists in Nigeria or elsewhere to explore replacement options for industrial trans fat?

Annex 2 - Stakeholders Interviewed

SN	GPZ	State	City/Town	Organisation	Category
1	NC	FCT	Abuja	Global Health Advocacy Incubator	Development partner
2	NC	FCT	Abuja	National Agency for Food and Drug Administration and Control (NAFDAC)	Regulatory agencies
3	NC	FCT	Abuja	World Health Organisation	Development partner
4	NC	FCT	Abuja	Double G Catering and Confectionery	Baking
5	NC	FCT	Abuja	Cinnekky & CO	Baking
6	NC	Plateau	Jos	Mike King Foods Bakery (M K Foods)	Baking
7		Plateau	Jos	Anonymous GC	Veg oil company
8	NC	FCT	Abuja	Quick Culinary	Snacks
9	NC	Plateau	Jos	Distri foods	Snacks
10	NW	Kano	Kano	L & Z Foods	Dairy
11	SE	Abia	Aba	Kitchen vegetable oil a subsidiary of J. Udeagabala	Veg oil company
12	SE	Imo	Owerri	Camela Vegetable oil	Veg oil company
13	SE	Anambra	Onitsha	Transtell	Veg oil company
14	SE	Anambra	Awka	Nigerian Medical Association (NMA)	Civil society association
15	SS	Edo	Benin	Anonymous PS	Veg oil company

SN	GPZ	State	City/Town	Organisation	Category
16	SS	Rivers	Porthar-court	Daily Tummies	breakfast cereals
17	SW	Oyo	Ibadan	Sudit oil & Chemicals/SlabMark Limited	Veg oil Company
18	SW	Oyo	Ibadan	Kingsway Quality Foods (Int'l) Ltd.	Snacks
19	SW	Lagos	Lagos	Bato Chemical Laboratories	Laboratory
20	SW	Oyo	Ibdan	Fortes and Hedges / Pitman Analytical	Laboratory
21	SW	Lagos	Lagos	NAFDAC Laboratory Oshodi	Laboratory
22	SW	Ogun	Abeokuta	Nutrition Society of Nigeria (NSN)	Civil Society Association
23	SW	Lagos	Lagos	Nigerian Heart Foundation (NHF)	Civil Society Association
24	SW	Ogun	Sango Ota	Sona Foods	Biscuit Company
25	SW	Oyo	Ibadan	Anonymous Marg	Margarine Company
26	SW	Oyo	Ibadan	Anonymous Marg	Margarine Company
27	SW	Lagos	Lagos	Anonymous Biscuit	Biscuit Company
28	SW	Oyo	Ibadan	Anonymous Biscuit	Biscuit Company
29	NC	Plateau	Jos	Alvaro Bakery	Baking
1	NC	Plateau	Jos	Anonymous Bakery	Baking
2	NC	Plateau	Jos	Anonymous Biscuit	Biscuit Company
3	SW	Lagos	Lagos	Anonymous Biscuit	Biscuit Company

Annex 3 – Summary of the workshop on the replacement of Industrially Produced Trans Fatty Acids in Nigeria. 29 October, Lagos, Nigeria

Introduction

The workshop focused on supporting Nigerian local companies in replacing iTFA. The focus and objectives of the meeting were about:

- Defining iTFA
- Explaining why iTFA need to be replaced
- Describing the role of relevant stakeholders in reducing iTFA in the Nigerian food supply chain
- Exploring what technologies are available for Nigerian companies
- Lessons learned from other countries on iTFA replacement
- Reviewing ongoing efforts to regulate iTFA in Nigeria including laboratory capacity.

Definition and health impact of iTFA

The main source of iTFA is usually hydrogenation of oils, the hydrogenation is partial thereby resulting in partially hydrogenated oils (PHO) or partially hydrogenated vegetable oils (PHVOs). Example of foods with iTFA are fast foods, fries, baked foods, bakery products like biscuit, doughnuts, cookeries, cake, fried chicken, ready to microwave popcorn, wafers etc.

iTFA consumption is associated with increased rates of coronary heart disease. A study conducted in 2010 by Wang, Qianyi et al. found that excess TFA consumption was estimated to cause 537 200 coronary heart disease deaths per year worldwide in 2010, representing 7.7% of global coronary heart disease mortality. It is critical to select replacement options that do not cause more harm after reformulation than the initial product. Therefore, saturated fatty acids in reformulated products should be smaller than the sum of iTFA and saturated fatty acids in the original product.

Possible Replacement options are fractionation, interesterification and blending. Most local companies based in emerging markets like Nigeria may not be able to afford the cost of these processes and the goal of the workshop is to determine what works for Nigeria and how we can come together to achieve complete elimination of iTFA while minimising replacement with saturated fatty acids by 2023, consistent with the goal of the WHO REPLACE initiative.

In response to the concerns of the participants, the international expert from IFBA member, Ferrero, explained that:

- The quality of oils tends to stay longer when you add antioxidant to it, even though this may be a tedious process.
- Oil should not be used for frying more than three times, to avoid the introduction of iTFA and it is best to discard the oil after two rounds of frying. To address the participants' concern of extra costs of not using the oils more than 2/3 times, IFBA members use the oil to generate power.

Regulatory environment of iTFA in Nigeria

It is critical that food producers and manufacturers comply with standards of safety and quality and aim at protecting public health. While balancing cost and profit, NAFDAC encourages companies that attended the meeting to promote public good and cause no harm.

NAFDAC has keyed into the WHO REPLACE strategy. Section 8 of the NAFDAC rules has been reviewed and revised to address the issue of iTFA. Products labelled trans fat free in Nigeria should contain less than 2g per 100grams. To achieve iTFA replacement in Nigeria, NAFDAC is planning to conduct a series of stakeholders' meetings. A meeting with the Nigerian CODEX unit is planned on iTFA in November 2019.

Typical Analysis of iTFA by NAFDAC includes:

- Hydrolysis
- Methylation
- Quantification (using GC-FID)

There is now a laboratory that has a detector and work is in progress for analysis of iTFA levels in products. NAFDAC is also looking at how to regulate street food vendors who do not fall under the federal control but under the local government.

Participants pointed out the need for strong protocols and research capacity within NAFDAC regarding iTFA measurement to understand the extent of iTFA consumption and ensure compliance with existing/future iTFA regulations. Additionally, a new nutrition survey would help assess the levels of iTFA consumptions as the latest nutrition survey was conducted in Nigeria in 1984.

Replacing iTFA in Nigeria, IFBA recommendations

To implement the REPLACE package, companies should innovate and provide accurate knowledge to consumers notably through proper labelling and responsible marketing.

The current reality on iTFA is that most countries are still above the limits of 2 grams per 100 grams of oils and fat. While achieving the limit of 0 gram of iTFA per 100 grams of oils and fats is not possible, all countries should aim to reach the 2 grams limit. A good laboratory evaluation does not only require equipment but also technical expertise among the staff. Local companies pointed out the opportunity to achieve trans fat free products by accessing a supply of trans fat free vegetable oil. Presco, a Nigerian company attending the meeting was an interesting example of economic sustainability through the control of their oil supply, as they use oil that they produce themselves and therefore are not dependent on imported oils and fats. This model also enables the company to control the content and health impact of the oil contained in its products.

Some participants called for a sub-regional approach to ensure that Nigerian consumers do not consume iTFA through imported products. However, the public representatives pointed out the need to start first with Nigeria which, considering its economic size, will have a major impact in Africa by setting standards on iTFA and making guidelines on iTFA replacement available to other countries. A number of participants were worried of unfair competition of imported products if the iTFA regulations were not be applied to them.

A commitment form was shared to SMEs participants to sign and return.

To support the local companies which attended the workshop in creating demand for trans fat free products, the moderator of the meeting shared basic principles of effective marketing for the introduction of new products:

- Assess the competition: know your competitors
- Identify your Customer
- Advertise: Choose your sales and marketing channels.

Conclusion

The next phase is to practically support approximately 10 companies – which would have signed the commitment form – to replace iTFA in their products. Five organisations representing three SMEs (Manufacturers of edible oil, groundnut paste and peanut snacks), one private laboratory and one organisation involved in capacity building and sensitisation campaign, signed commitment forms for iTFA reduction in Nigeria.

Business can change to provide healthier products, and it is of note that fighting malnutrition is not just good for health, it is good for business.

Scaling Up NUTRITION Business Network
ENGAGE • INSPIRE • INVEST

www.sunbusinessnetwork.org

Contact
Global Alliance for Improved Nutrition (GAIN)
Rue de Varembé 7
1002 Geneva, Switzerland

T: +41 22 749 18 50
E: info@gainhealth.org
www.gainhealth.org

gain
Global Alliance for Improved Nutrition