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

A report on sources and replacement solutions for iTFA in Pakistan

June 2020
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6.4 Support demand for iTFA free products/compliant products

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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 June 2020.
A report on sources and replacement solutions for iTFA in Nigeria
Mapping of Industrially-produced Trans-fat (iTFA) in Nigeria
1. Executive summary

The consumption of industrially-produced trans fatty acids (iTFA) is recognized as a major dietary risk factor for heart disease. To address this issue WHO launched the REPLACE initiative which aims to eliminate iTFA in global food supplies by 2023. In Pakistan, one of the main sources of iTFA consumption is vanaspati ghee (a fully or partially hydrogenated vegetable cooking oil) followed by industrial margarines. The maximum content of iTFA in these products is estimated between 34% and 24% respectively. Through the production of processed foods using ingredients such as vanaspati ghee and industrial margarines, iTFA ends up in a broad range of locally produced food such as biscuits, cakes and snacks.

The Pakistani fat and oil industry would benefit from external support to replace iTFA across its food value chain. Following the trends of many other countries, the number of products containing iTFA have gradually increased in the past decades in Pakistan due to iTFA’s positive impact on the food texture, flavor stability and the shelf life of the product.

The report identified interesterification (chemical or enzymatic), and a combination of dry fractionation and blending as the most relevant processes to achieve iTFA replacement in Pakistan. Currently chemical interesterification processing is available in a very limited number of locations in Pakistan. Enzymatic interesterification still needs to be introduced in Pakistan and the initial investment cost as well as high running cost and capacity needs are a big hurdle for the installation of interesterification units. Dry fractionation and blending of various fractions of fat exist in Pakistan.

To ensure successful iTFA replacement by the industry in Pakistan by 2023, the report advised four key recommendations:

- Provide technical support to the industry around iTFA elimination.
- Support consumer education on the negative health impact of iTFA consumption.
- Implement consistent regulations on iTFA for local and imported products across the country.
- Support demand for iTFA free products.
Mapping of industrially-produced Trans-fatty acids (iTFA) in Pakistan

1. Executive summary
2. Overview

The World Health Organization (WHO) has made iTFA replacement one of its priorities. Its 13th general programme of work 2019-2023 states that: “evidence-based WHO guidance will support countries to eliminate artificial trans-fats.” Increased intake of iTFA is associated with increased risk of coronary heart disease (CHD) events and mortality. Globally, iTFA cause an estimated 540,000 deaths each year.1 The iTFA-associated mortality burden could be even higher than the global average in Pakistan, as per capita consumption of iTFA is one of the highest among the global community.2 Despite the global negative impact of iTFA, the Access to Nutrition Index (2018) reports that only 20% of the 193 countries have policies in place to address trans fat replacement, reflecting the need for additional interventions to replace iTFA in the food value chain in order to implement policy measures recommended by WHO to achieve the elimination of iTFA from the global food supply by 2023.

A situational analysis on TFA elimination in Pakistan published in July 2019 by Heartfile states that “Pakistan’s trans-fat intake is estimated to be the 2nd highest in the WHO-EMRO region after Egypt.”

To address the negative health consequences of iTFA consumption, WHO has launched the REPLACE action package which outlines six strategic action areas to achieve global iTFA elimination. In Pakistan, activities have been recently initiated to implement actions from the REPLACE package.

The WHO’s REPLACE action package serves as a guide for countries to implement actions to reduce and eliminate iTFA, and outlines six strategic action areas to support the prompt, complete, and sustained elimination of iTFA from the food supply:

REviewing dietary sources of iTFA and the landscape for required policy change,

P romoting the replacement of iTFA with healthier fats and oils,

L egislating or enacting regulatory actions to eliminate iTFA,

A ssessing and monitoring TFA content in the food supply and changes in TFA consumption in the population,

C reating awareness of the negative health impact of TFA, and

E nforcing compliance with policies and regulations.

WHO Pakistan in collaboration with the Pakistan Ministry of National Health Services, Regulations and Coordination initiated the first action package’s activity regarding the review of the dietary sources of iTFA. Building on this first round of actions and focusing on the implementation of the second action package’s activity, the International Food and Beverage Alliance (IFBA) and the Global Alliance for Improved Nutrition (GAIN)/SUN Business Network (SBN) have started the implementation of a multi-stakeholder pilot project in Pakistan. The pilot will support the identification of iTFA replacement solutions in the food value chain with funding from Resolve to Save Lives, an initiative of Vital Strategies. This report is part of the pilot project and will guide the implementation of business to business technical assistance to replace iTFA in the food production of local companies in Pakistan. The study maps the use and replacement solutions of iTFAs in the food value chain in Pakistan. It focuses on the challenges and opportunities of identifying and implementing iTFA replacement solutions across the industry – including small and medium enterprises - in the context of Pakistan.

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2 Heartfile, Trans-Fatty Acid elimination in Pakistan: A situational analysis, July 2019.
3 Heartfile, Trans-Fatty Acid elimination in Pakistan : A situational analysis, July 2019.
Mapping of industrially-produced Trans-fatty acids (iTFA) in Pakistan

2. Overview
3. Methodology

The study was conducted through the implementation of the following tasks:

- Desk research and interviews of food companies in Pakistan to map the use of iTFA in each aspect of their food value chain.
- Meetings and interviews with relevant national and local stakeholders (government and private sector) to collect and assess existing data.
- Review of different iTFA replacement solutions with an indication of availability in the country context, of the cost and of the technical difficulties around its implementation for the food manufacturers.
- Write a comprehensive report with all supporting data and documents in annexes of the iTFA mapping and provide recommendations.

The proposed methodology to undertake this study is elaborated below.

3.1 Collection of Secondary Data on Trans fatty acids

Data on prevalence of iTFA in Pakistani diet, fat and food products was gathered. The research work on trans fat content in fats and oils and food products was accessed through Google Scholar and ResearchGate. Original articles were retrieved and reviewed based on their inclusion in the Journal Citation Reports (JCR), listed in the Scientific Journal Rating, inclusion of Pakistani food and fat and oil products review. Earlier studies such as the one published by Heartfile in 2019 were reviewed for drawing a conclusive picture of prevalence of iTFA in fat and food products. This data was used to identify the stakeholders to be contacted and interviewed for current study.

3.2 Interviews of companies to map the use of iTFA in food value chain

Representatives of food companies were interviewed to map the use of iTFA in the food value chain. The products considered for their potential high content of iTFA were: fat products e.g. vanaspati ghee, industrial margarines and table margarines as well as processed food and confectionary items e.g. biscuits, cakes, chocolates, pastries, snacks, branded potato chips, etc. A questionnaire was designed by the SBN global team covering all the relevant queries into consideration. The questions were translated into Urdu to facilitate interviews with the local industry. Questionnaire is attached as Annexure III. Additionally, the input provided by private and public stakeholder representatives during a day and a half workshop on 22-23 January 2020 in Karachi was included in this report.

5 Heartfile, Trans-Fatty Acid elimination in Pakistan: A situational analysis, July 2019.
3.3 Review of different iTFA replacement solutions

iTFA replacement options were reviewed and screened for their local availability, cost, health benefits and feasibility of technical implementation by food manufacturers - based on information available. The study also looks at possible ways to overcome some of the technical issues related to the implementation of the replacement solutions.

Pakistan’s trans-fat intake is estimated to be the 2nd highest in the WHO-EMRO region after Egypt.

Heartfile, Trans-Fatty Acid elimination in Pakistan: A situational analysis, July 2019.
1. Executive summary

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Mapping of industrially-produced Trans-fatty acids (iTFA) in Pakistan

1. Executive summary
4. Trans Fats in Pakistani Food Supply Chains

Fats and oils containing iTFA are vegetable fat and oils that have gone through the industrial process of hydrogenation to make them solid to use for different reasons such as increasing shelf life, flavor, texture etc. Oil comes either refined or in a raw form which is refined and then processed to manufacture different products. Processors develop products to serve different markets including food industry, bakeries, hotels, restaurants and households.

Industrial margarine and shortening are prepared for the food processors and industry. Hydrogenation is used to solidify the oil and its melting point increases with hydrogenation. Pakistan uses two types of ghee with an increased consumption of vegetable ghee – source of iTFA – in the latest decades. Desi Ghee is the original ghee used in the country and is extracted from butter/milk sources. Desi Ghee is a semi-liquid product that contrary to butter can be stored outside of the cold chain. Vanaspati Ghee is a type of vegetable ghee which contains partially hydrogenated oil, it leads to high level of iTFA consumption in Pakistan especially when used at a high temperature.

Vanaspati ghee is largely consumed, and consumers have fully adopted this as a cooking vehicle. Vanaspati ghee was primarily introduced as resembling substitute to Desi ghee which was made possible through hydrogenation in the early stages. Historically, people have been consuming Desi ghee as a cooking vehicle which with the advent of vegetable oil has reduced. Similarly, hydrogenation of oil is used to prepare shortening and margarine which is requirement to develop different shape and texture to food products.

Vanaspati ghee and processed products made from industrial margarine are major contributors of iTFA consumption in Pakistan. The map below shows the supply chain of oils and fats and food products. Pakistan imports raw oil from different countries and processing into different industrial and consumer products made by the local manufacturers.

At consumer level, providing alternatives to ghee and packaged oil containing iTFA will ensure significant health benefits.

The July 2019 situational analysis from Heartfile has established that: “In Pakistan, the main dietary sources of TFA include vanaspati ghee, margarines, bakery shortenings and cooking oil. As these oils and fats are widely used for cooking and baking purposes in Pakistan, including widespread usage in homes, they lead to high TFA levels across a wide variety of food products, including biscuits, chocolates, pastries, breakfast foods, french fries, and breakfast cereals. The main industries that are the source of iTFAs in the Pakistani context are edible oil, margarine and the bakery and confectionary industry. […] The bulk of trans-fat sources in Pakistan are locally produced (about 98%) and one concentrated in the edible oil, margarine and baking sectors.”

While a large part of edible oil consumed in Pakistan is imported (2.9m tons), Heartfile reports that 0.4m tons of edible oil are still produced domestically.

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6 Heartfile, Trans-Fatty Acid elimination in Pakistan: A situational analysis, July 2019.
7 Heartfile, Trans-Fatty Acid elimination in Pakistan: A situational analysis, July 2019.
According to a 2019 survey from the Gilani Research Foundation which was carried out by Gallup & Gilani Pakistan, “45% Pakistanis claim that Ghee is mostly used for cooking in their house followed by 40% who cite packaged oil as the most used oil for cooking.” The survey asked a representative sample of men and women from Pakistan four provinces: “What kind of oil is used for cooking in your house?” 45% of the respondent indicated vanaspati ghee vs 7% for desi ghee (which is from animal sources).8

8 Gallup website, Oil consumption: 45% Pakistanis claim that Ghee is mostly used for cooking in their house, 16 May 2010.
Prices of Fat and Oil Products in Pakistan

Vanaspati ghee, the major carrier of iTFA in Pakistan, is a cheaper option than refined oil products. For example, in June 2019 the average price of cooking oil was 5% higher than the average price of vanaspati ghee.

Table 1: Prices of fat and oil products (June 2015-June 2019).

<table>
<thead>
<tr>
<th>Products</th>
<th>June 2015</th>
<th>June 2016</th>
<th>June 2017</th>
<th>June 2018</th>
<th>June 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooking oil, Tin (2.5 litre)</td>
<td>467.00</td>
<td>454.35</td>
<td>469.59</td>
<td>476.88</td>
<td>525.99</td>
</tr>
<tr>
<td>Vanaspati ghee, Tin (2.5 litre)</td>
<td>459.35</td>
<td>445.12</td>
<td>462.53</td>
<td>471.41</td>
<td>505.15</td>
</tr>
</tbody>
</table>


Figure 2: Prices of fat and oil products (June 2015-June 2019).

4.1 Levels of iTFA in Oils and Fats

The levels of iTFA in vanaspati ghee brands vary but they are generally above the safe levels recommended by WHO. Below is the summary of findings of studies conducted to test the level of iTFA in oils and fat products.

Vanaspati ghee and industrial margarine have high level of iTFA while butter, cooking oil and table margarine have lower level of iTFA. However, consumer demand for vanaspati ghee remains high. Cooking oil are available at a higher price than vanaspati ghee in Pakistan and the government has not yet launched an effective promotion campaign to increase the consumption of cooking oil. Most of the ghee manufacturers are also producing cooking oil brands but market penetration of cooking oil versus vanaspati ghee is low.

Dalda (former Unilever) is one of the premium brands that introduced trans fat free vanaspati ghee in 1998. Dalda markets its products as healthy and trans fat free. Similarly, there are four other premium brands that have reduced iTFA content through blending and other techniques. The trans fat free products are consumed by the high-income part of the Pakistani population. All the premium brands have both cooking oil and Vanaspati brands. However, the lower income part of the Pakistani population does not currently have access to trans fat free vanaspati ghee or healthier cooking oils due to their higher cost.

This analysis demonstrates the needs for affordable replacement solutions to iTFA products in Pakistan as there are no current solutions accessible for low income consumers in the country.

4.1.1 Vanaspati ghee

iTFA values observed in samples of vanaspati ghee are alarmingly high in vanaspati ghee. iTFA content in five popular brands of vanaspati ghee in Pakistan was found to be significantly high during a study conducted in 2012 and ranged up to 33%. In an earlier study conducted in 2004 on 34 brands of hydrogenated vegetable oil/ vanaspati ghee, it was noted that iTFA in vanaspati ghee samples remained high and ranged from 14.2 to 34.3%.

4.1.2 Margarines

In Pakistan, industrial margarines are usually prepared from partially hydrogenated vegetable oils which results in elevated levels of iTFA in finished products. In hard-type bakery margarines iTFA content ranged from 9 to 19g per 100g of fat of the product in a study on five bakery margarines. iTFA value was observed in another instance as high as 24g per 100g of fat.

Whereas in a study on five soft-type table margarines iTFA content was assessed at maximum 5g of iTFA per 100g of fat with an average of 3.5g per 100g of fat. Some of the commercially available brands of table margarines are however producing products with no more than 2g of iTFA per 100g of fat.
4. Trans Fats in Pakistani Food Supply Chains

4.1.3 Butter

The commercially available butter in the country has on average a bit less than 5g of iTFA per 100g of fat.\(^{15}\)

4.1.4 Cooking Oil

iTFA content in cooking oil has been reported at low levels between 0.4 and 1.8g of iTFA per 100g of fat.\(^{16}\)

4.2 Levels of iTFA in Processed Food Products

Food manufacturers use the various types of fats and oils described above in the production of processed food products resulting in different levels of iTFA content in those products.

4.2.1 Biscuits and cakes

In 2008, iTFA content of 12 brands of biscuits was assessed and high amounts were observed in all biscuit samples, ranging from 9 to 35g per 100g of fat. The high content of iTFA and palmitic acid also indicated that blends of refined, bleached and deodorized palm oil and partially hydrogenated oil had been used in the biscuit manufacturing.\(^{17}\)

Commercial biscuits are carrying high level of iTFA in Pakistan due to vanaspati ghee and shorting use for their manufacturing.\(^{18}\) In a few high-end bakeries butter is being used for cookies manufacturing.

4.2.2 Chocolate and pastries

High amounts of iTFA have been observed in chocolate and pastries samples, varying respectively from 4.5g to 8.5g per 100g of fat and 4g to 10g per 100g of fat.\(^{19}\)

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4.2.3 Snacks

A study carried out in 2010 on some breakfast cereals showed that these contain varied amounts of iTFA contents ranging from 14 to 16g per 100g of fats in breakfast cereals. Different kind of deep fried snack and fast food collected from various eateries were analyzed for their iTFA content: potato chips 5 to 14g per 100g of fat, fried chicken 2 to 21g per 100g of fat; fried fish 3 to 7g per 100g of fat. The data generated in previous studies shows that various snack items e.g. puri, samosa, paratha etc. have high content of iTFA. Doughnuts sampled show levels of iTFA up to 39g per 100g of fat and poori had up to 19g per 100g of fat. However, snacks manufacturing is an informal sector based on small outlets and restaurants. To eliminate iTFA from this sector requires to control iTFA level in vanaspati ghee supplied to food manufacturers.

4.2.4 Salty snacks and Potato Chips

Salty snacks and potato chips’ consumption is widespread across the country. While no study to assess iTFA content of these industrial products have yet been conducted, thorough investigation shows that these are being fried in palm olein. The selection of palm olein is largely based on its good friability, cost and shelf life of product. All frying units in Pakistan buy palm olein from refineries or importers in bulk containers. iTFA is also generated during repeated frying.

If engagement focuses on fat and oil suppliers, iTFA intake can be substantially reduced. Additionally, the majority of manufacturers of snacks, biscuits and cakes has to be engaged to adopt better technologies, inputs and processes to reduce trans fats.

The majority of manufacturers of snacks, biscuits and cakes has to be engaged to adopt better technologies, inputs and processes to reduce trans fat.
1. Executive summary

A report on sources and replacement solutions for iTFA in Pakistan
Mapping of industrially-produced Trans-fatty acids (iTFA) in Pakistan

1. Executive summary
5. iTFA Replacement Solutions for Pakistani businesses

Processed fats and oils are important functional ingredients in food. Different functionalities (e.g., mechanical strength, laminating and shortening ability) require specific compositions that may not be found in a single natural fat or oil. Melting behavior, solid fat content, and fat crystal habit or network are important factors in creating food such as margarine and shortenings; whereas, decreasing polyunsaturated fatty acids to increase oxidative stability is important for frying oil. Modification methods for oils and fats include blending, modified hydrogenation, interesterification (chemical or enzymatic) and genetic improvement.

5.1 Challenges and opportunities for Pakistan companies

5.1.1 The opportunities of iTFA replacement for businesses

The shift from unpackaged to packaged edible oils in Pakistan\(^2\) creates a strong opportunity for iTFA replacement as manufacturers have the opportunity to label and market their products and consumers are now accessing content information when purchasing edible oils.

The current effort to implement regulations on iTFA content at local and national level is a major incentive for businesses to replace iTFA across their portfolio. With the design of a governmental plan of action for iTFA elimination in the Pakistani food value chain by 2023, businesses will need to invest in iTFA replacement solutions. This plan has been articulated around four objectives:

- Enact and implement regulatory actions to eliminate TFA in Pakistan
- Enforce compliance with TFA policies and regulations
- Create awareness of the negative health impact of TFA among policy makers, suppliers and the public in Pakistan
- Promote the replacement of iTFA with healthier fats and oils.

Additionally, consumer demand for trans fat free products is perceived as a key incentive for business investments on iTFA free products. Increased opportunities for exportation are mentioned by industry representatives as an incentive to produce products below the WHO recommendation of 2g of iTFA per 100g of fat. The Karachi workshop participants voted by a show of hands that consumer demand would be a stronger driving force for them than regulations for iTFA replacement. Consumer awareness campaign can explain that slight changes of appearances and textures of current products can be beneficial for them.

The potential provision of free technical support to the industry is an opportunity for iTFA replacement. During the January 2020 Karachi workshop, several global companies, including IFBA members, indicated that they have expertise on iTFA replacement solutions which can be beneficial to Pakistani companies. Upfield Pakistan for example indicated that they have an almost negligible 0-0.1% iTFA content in their products. PepsiCo raised the expertise and availability of their staff on fats and oils which can support local companies around iTFA replacement.

Other opportunities can be created by the public sector to foster iTFA replacement, for example reduced import duties and taxes on imported iTFA free oils.
5.2.2 The main challenges of iTFA replacement for businesses

According to a literature review, interviews and input from the January 2020 Karachi workshop on iTFA, the main challenges for iTFA replacement in Pakistan are:

- High demand for products containing iTFA especially vanaspati ghee and its grainy texture which required high iTFA content.
- Limited knowledge across local companies around the negative impact of fat and oil frying (at very high temperature and multiple times) and the fact that it creates iTFA.
- Limited infrastructure and staff capacity are another challenge to design/implement iTFA replacement solutions. This includes lack of laboratory capacity to self-assess iTFA content but also underqualified staff to implement iTFA replacement solutions or lack of space to install new equipment.
- Low/non existing demand for iTFA free products due to low level of consumer awareness of iTFA related health issues. Consumer demand for trans fat free products is also limited by the purchasing of power in the country – classified by the World Bank as a lower middle-income country – and the need to provide solutions that do not increase the products’ prices. Participants of the Karachi workshop stated that it was very ambitious to create sufficient level of consumer demand for products complying with WHO recommendation on iTFA within the three-year period remaining to achieve WHO target of iTFA elimination.
- Lack of laboratory facilities for iTFA assessment managed by regulatory agencies.
- Raw material choice is limited, main ingredients of vanaspati ghee are partially hydrogenated palm oil and olein (selected because of their price). The regulatory authorities are assessing the potential need to lift the ban on palm stearin to support iTFA replacement.
- Heterogeneity of current iTFA compliance in the country which create ambiguity for the industry. The decision of the Pakistan Standards and Quality Control Authority to develop iTFA regulation in consultation with the provinces should support the gradual alignment of regulations across the country.
- When specifically choosing raw materials, food manufacturers need to balance health impact with several criteria such as:
  - Price.
  - Best applicability for intended use e.g. frying etc.
  - Seasonal oil crop.
  - Resistance to rancidity.
  - Chemical specifications of oil e.g. moisture, free fatty acids are the most important whereas other peroxide value, soap content, solid melting point, rancidity, iodine value should match the required standard of the processor as well.
  - Quality factors like contamination of heavy metals and other chemical and microbial hazard.

The industry is using cost effective raw materials (oils), usually imported. In case of any change in raw material an increase in cost is expected. This cost may be associated with the price of raw material or consequential increase in processing needed e.g. increased hydrogenation requirements. It will result in an increase in the end-product price. Prices are already quite high due to current economic condition of the country as well as unfavorable exchange rate of Pak Rupee. It is feared that the change in raw material may result in loss of production capacity as well as decreased consumer demand. Product quality may also be affected in case of these changes. One given example of such implications could be the replacement of palm oil with rapeseed oil which will result in a product with an off flavor and short shelf life. Moreover, suitable replacement options need to be identified for various applications.
5.2 Blending

Blending of palm oil products and liquid vegetable oils to match vanaspati ghee required consistency and melting point is feasible. Blending of palm stearin with soybean, rapeseed and sunflower oils is also suitable for iTFA free vanaspati ghee production. Direct blending of 60% palm stearin and 40% liquid vegetable oil produces the most acceptable low melting vanaspati ghee, while 95% palm oil and 5% palm stearin can produce vanaspati ghee of 38°C melting point. The product appears homogenous and has a soft consistency with no oil separation. The implementation of this solution will be facilitated by the lift of the current ban on palm stearin in Pakistan.

The formula gives a rather smooth but inexpensive product with no iTFA. For increased granularity, part of the palm oil is replaced with hydrogenated soybean oil. An example of such formulation is given below:

**Table 2: Trans Fat Free Vanaspati Formulation-1 (SMP approx. 40°C)**

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Palm stearin</td>
<td>20%</td>
</tr>
<tr>
<td>Palm oil</td>
<td>80%</td>
</tr>
</tbody>
</table>


**Table 3: Trans Fat Free Vanaspati Formulation-2 (SMP approx. 40°C)**

<p>| | |</p>
<table>
<thead>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Palm stearin (IV 44)</td>
<td>20%</td>
</tr>
<tr>
<td>Palm oil</td>
<td>40%</td>
</tr>
<tr>
<td>Hydrogenated soybean oil (32°C)</td>
<td>40%</td>
</tr>
</tbody>
</table>

Table 4: Solid Fat Content Profiles and Slip Melting Points of Vanaspati Formulations with at least 30% Palm Oil.

<table>
<thead>
<tr>
<th>Formulation</th>
<th>SMP (ºC)</th>
<th>10ºC</th>
<th>20ºC</th>
<th>30ºC</th>
<th>35ºC</th>
<th>40ºC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm stearin (IV 44) Hydrogenated soybean oil (32ºC) 50%/50%</td>
<td>467.00</td>
<td>454.35</td>
<td>454.35</td>
<td>469.59</td>
<td>476.88</td>
<td>525.99</td>
</tr>
<tr>
<td>Hydrogenated palm olein (43ºC) Palm oil 30%/70%</td>
<td>459.35</td>
<td>445.12</td>
<td>445.12</td>
<td>462.53</td>
<td>471.41</td>
<td>505.15</td>
</tr>
<tr>
<td>Palm stearin (IV 44) /Hydrogenated soybean oil (36ºC) 40%/60%</td>
<td>467.00</td>
<td>454.35</td>
<td>454.35</td>
<td>469.59</td>
<td>476.88</td>
<td>525.99</td>
</tr>
<tr>
<td>Palm oil/Hydrogenated soybean oil (30ºC) 30%/70%</td>
<td>459.35</td>
<td>445.12</td>
<td>445.12</td>
<td>462.53</td>
<td>471.41</td>
<td>505.15</td>
</tr>
<tr>
<td>Interesterified blend (70% palm stearin/30% rapeseed oil)</td>
<td>467.00</td>
<td>454.35</td>
<td>454.35</td>
<td>469.59</td>
<td>476.88</td>
<td>525.99</td>
</tr>
</tbody>
</table>


Palm oil, which is naturally semi solid, is one of the preferred alternatives for trans free margarine. Various formulations have been developed for itFA free margarine by either straight blending or interesterification. The melting properties are correspondingly improved, especially in blends of palm stearin with liquid vegetable oils.

Table 5: Examples of formulations by MPOB of oil blends for table, polyunsaturated (tub), low saturated (stick) and shelf stable (can) margarines.

<table>
<thead>
<tr>
<th>Product Code</th>
<th>F 209</th>
<th>F 214</th>
<th>F7</th>
<th>2900</th>
<th>2105</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm stearin (IV20)</td>
<td>4</td>
<td>12</td>
<td>5</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Palm olein (IV58)</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid oil</td>
<td>64</td>
<td>80</td>
<td>65</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Palm kernel oil</td>
<td>8</td>
<td></td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm oil</td>
<td></td>
<td></td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE blend of 32/8 palm stearin (IV44)/ palm kernel olein</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 6: Formulations of Oil Blends for Packet Margarines.

<table>
<thead>
<tr>
<th>Component</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid oil</td>
<td>40</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>Palm olein</td>
<td>–</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Palm stearin (a)</td>
<td>–</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Palm kernel oil</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blend (b)</td>
<td>50</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Palm oil</td>
<td>–</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

**Solid fat content %**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5°C</td>
<td>58</td>
<td>40</td>
<td>37.7</td>
</tr>
<tr>
<td>10°C</td>
<td>–</td>
<td>28</td>
<td>34.5</td>
</tr>
<tr>
<td>15°C</td>
<td>–</td>
<td>18</td>
<td>26.5</td>
</tr>
<tr>
<td>20°C</td>
<td>20</td>
<td>8.5</td>
<td>17.7</td>
</tr>
<tr>
<td>25°C</td>
<td>–</td>
<td>5</td>
<td>11.6</td>
</tr>
<tr>
<td>30°C</td>
<td>7</td>
<td>2.5</td>
<td>6.8</td>
</tr>
<tr>
<td>35°C</td>
<td>2.5</td>
<td></td>
<td>2.1</td>
</tr>
</tbody>
</table>

Table 7: All-purpose Domestic and Industrial Cake Margarine Formulations.

<table>
<thead>
<tr>
<th></th>
<th>F234</th>
<th>F233</th>
<th>F274</th>
<th>F276</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm stearin (IV 30)</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm oil</td>
<td>52</td>
<td></td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Liquid oil</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm kernel oil</td>
<td>8</td>
<td>10</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Palm olein (IV 58)</td>
<td></td>
<td>67</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Palm stearin (IV 33)</td>
<td></td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm stearin (IV 36)</td>
<td></td>
<td></td>
<td>22</td>
<td>25</td>
</tr>
<tr>
<td>Palm stearin (IV 14)</td>
<td></td>
<td>8</td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>


Some example of iTFA free puff pastry formulations are shown in the table below.

Table 8: Global Pastry Margarine Formulations.

<table>
<thead>
<tr>
<th></th>
<th>F215 (%)</th>
<th>F133 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm stearin (IV 30)</td>
<td>50</td>
<td>13</td>
</tr>
<tr>
<td>Palm olein (IV 58)</td>
<td>45</td>
<td>30</td>
</tr>
<tr>
<td>Liquid oil</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Palm stearin (IV 19)</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Palm oil</td>
<td>0</td>
<td>32</td>
</tr>
</tbody>
</table>


The benefits and challenges regarding the implementation of blending by Pakistani companies to replace iTFA were assessed as follows:

- SFA content can be controlled and this leads to low iTFA content.
- Skillful professionals are required for the implementation of this process.
- Diverse Raw Materials Available.
- Difficulties in matching sensory perception of iTFA products for consumers.
5.3 Interesterification

The interesterification process rearranges the distribution of the fatty acids either chemically or enzymatically within and between the triglyceride molecules; thus, the fatty acid distribution is altered but the fatty acid composition remains the same. Interesterification modifies the melting and crystallization behavior of the fat, thus producing fats with the desirable physical properties of trans fats but without introducing iTFA. One current application of this process is in the production of trans-free or low-trans fats spreads, margarine, and shortening.

Interesterification can be used to harden single oils or to alter the melting profiles of blends, without producing any such isomers and without any overall change in the unsaturation. A particularly useful effect is removal of the ‘tail’ from the melting profile of some blends containing appreciable high melting fats, such as palm stearin. Interesterified blends of palm stearin and palm kernel oil or its olein are suitable. Some interesting examples of such blends, studied by the Malaysian Palm Oil Board and recommended for margarine and shortening, are described below.

The table below gives some example of interesterified blends of palm oil products with soft oils as major components in margarine and shortening.

<table>
<thead>
<tr>
<th>Product Code</th>
<th>IE</th>
<th>IE</th>
<th>IE</th>
<th>IE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm kernel oil</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm oil</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PKOo</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POS (IV33)</td>
<td>90</td>
<td>20</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Rapeseed oil</td>
<td></td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soybean oil</td>
<td></td>
<td>60</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


It is fairly easy to do a direct comparison between chemical and enzymatic interesterifications. When comparing partial hydrogenation with interesterification, hard fat fraction variations between an expensive fully hydrogenated fat or an inexpensive tropical fat need to be considered. The process of enzymatic interesterification can easily be implemented in existing factories for continuous operation. As no chemicals are used and the operating conditions are mild, the only post-treatment needed is deodorization.
Mapping of industrially-produced Trans-fatty acids (iTFA) in Pakistan

5. iTFA Replacement Solutions for Pakistani businesses

Table 10: Interesterification cost (for unit with 100 tons per day; 30000 tons per year capacity)\textsuperscript{24}

<table>
<thead>
<tr>
<th>COST</th>
<th>CIE</th>
<th>CIE(1)</th>
<th>EIE(1)</th>
<th>EIE(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalyst usage kg/ton</td>
<td>1</td>
<td>0.5</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>OPEX US$/ton</td>
<td>~27</td>
<td>~21</td>
<td>~35</td>
<td>~24</td>
</tr>
<tr>
<td>CAPEX US$/ton (5-year depreciation)</td>
<td>~15</td>
<td>~15</td>
<td>~12</td>
<td>~14</td>
</tr>
<tr>
<td>Total:</td>
<td>~42</td>
<td>~36</td>
<td>~47</td>
<td>~38</td>
</tr>
</tbody>
</table>

(1): incl. pre-deodorisation
(2): incl. chromatographic silica

Table 11: Cost and Attributes Comparison between CIE and EIE

<table>
<thead>
<tr>
<th>Comparison</th>
<th>CIE</th>
<th>EIE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preferred operation:</td>
<td>batch</td>
<td>continuous</td>
</tr>
<tr>
<td>Proven</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost:</td>
<td>~36-42 US$/ton</td>
<td>~38-47 US$/ton</td>
</tr>
<tr>
<td>Comparable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality:</td>
<td>good</td>
<td>good</td>
</tr>
<tr>
<td>Physical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organoleptic</td>
<td>good</td>
<td>better</td>
</tr>
<tr>
<td>Health impact</td>
<td>good</td>
<td>better</td>
</tr>
<tr>
<td>Consumer</td>
<td>Acceptable</td>
<td>Acceptable more natural</td>
</tr>
</tbody>
</table>

5.3.1 Chemical interesterification

The challenges and opportunities for the implementation of chemical interesterification to replace iTFA in the Pakistan context were assessed as follows:

- SFA content can be controlled.
- The process involves the use of chemical reactants/catalysts and proper management of waste.
- The process leads to iTFA free products.
- Raw Material is Available.
- It works in concomitance with hydrogenation processes.
- It provides a desirable Premium Product
- It is technically complex to implement.

5.3.2 Enzymatic interesterification

Chemical interesterification has been popular for commodity fats production whereas enzymatic interesterification has been used for specific high value-added fats/oils production. However latest innovations in technology have resulted in cost effective enzymatic interesterification process development to produce commodity fats (bakery fats, table spreads and shortenings). There is an increased interest for enzymatic interesterification versus chemical interesterification due to the latter being more environmentally friendly. In enzymatic interesterification bio-catalysts are used and severe process conditions are avoided without any harmful side reactions. Moreover, in enzymatic interesterification there are less oil losses with better overall product quality.

Enzymatic interesterification process is a rather simple process:

```
Crude Oil
↓
Pre Treatment
Neutralization-Bleaching-Deodorization

Enzymatic interesterification

Deodorization
(Brush)

Enzymatic interesterified Oil
```

Enzymatic interesterification could be a cost-effective alternative to chemical interesterification:

- Better quality interesterified oil
- Milder conditions (no chemicals)
- Far less oil losses and no side streams
- Already implemented by some of the industry

Market/consumer will be the ones deciding if and how fast enzymatic interesterification will replace chemical interesterification.

The challenges and opportunities for the implementation of enzymatic interesterification to replace iTFA in the Pakistan context were assessed as follows:

- SFA content can be controlled.
- Enzymes safety issues need to be managed.
- The process leads to iTFA free products,
- Raw Material is Available.
- It requires high capital investment and running cost.

Kellens and Gibon, 2015.
5.4 Modified hydrogenation process

Full hydrogenation of vegetable oils would produce exclusively saturated fatty acids that are too waxy and solid to use in food production. Consequently, the partial hydrogenation process used by the industry is not intended to eliminate all the double bonds. Partially hydrogenated oils increase the shelf life and flavor stability of foods, as well as modify some of the saturated fatty acids that can oxidize and become rancid. Modification of processing conditions of hydrogenation\(^26\) (e.g. pressure, temperature, and catalyst) affects the fatty acid composition of the oil product, including the amount of iTFA formed, and properties such as melting point and solid fat content of the oil. It is possible to make equivalently performing low-trans fats by increasing the degree of hydrogenation. It reduces the level of iTFA but increases the level of saturated fatty acids.

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.

Typical process conditions for partial hydrogenation in Pakistan are

**Temperature:** 150-180°C

**H\(_2\) Pressure:** 1-2 bars

**Catalyst:** Ni-catalyst (100 ppm Ni)

iTFA content is the result of function of temperature, pressure and catalyst. Higher temperature gives more iTFA, higher pressure and more Ni produces less iTFA.

Low trans partial hydrogenation requires modified process conditions with:

- high Pressure hydrogenation (20 bar),
- low temperature hydrogenation and precious metal (Pd, Pt)
- catalysts or zeolite-based catalysts.

Processing conditions implemented by local industry have been investigated and these including processing time, catalyst used, temperature, types of oil, proportion of oil, hydrogen pressure are reported in Annexure I.

Many mills are equipped with temperature or pressure control gauges whereas few are using the visual inspections techniques to control the process of hydrogenation. Standard operating procedures are available for almost all mills. In a few instances these require to be updated and to be detailed. Roughly 5% mills belong to large enterprises category (production capacity: 8000 MT/month), 10% to medium enterprises category (<8000 MT to 2000MT/month) whereas 85% industry falls in low enterprises category (<2000 MT/month). Their working capacity data is not precisely available.

The challenges and opportunities regarding the implementation of modified hydrogenation processes to replace iTFA in the Pakistan context were assessed as follows:

- There is a higher chance of catalysts being carried over.
- The process can still generate some iTFA and high SFA content.
- Raw Material is Available.
- Technology/plant machinery to implement the process is easily available.
- The process has high operational costs.

Alternatively, for the implementation of full hydrogenation, the industry would need the current ban on palm stearin to be lifted.
5.5 Animal fat

Historically, Desi ghee from animal source has been highly consumed in Pakistan. However, the high level of saturated fat in desi ghee makes it a challenging replacement solution. WHO recommends replacing desi ghee with oils rich in polyunsaturated fat. Additionally, the high cost of dairy product versus partially hydrogenated oil in the region would be an issue for consumers.

The challenges and opportunities regarding the replacement of iTFA by animal fat in the Pakistan context were assessed as follows:

- It has high SFA content and low levels of trans fat.
- It is costly.
- It requires a shift in dietary habits from consumers.

Animal fat is a challenging replacement solution of iTFA due to its SFA content, cost and local dietary habits.”
5.6 Alternate vegetable oils/trait-enhanced oils

Mustard oil used to be largely produced and consumed in Pakistan; however, studies from the 1970s have shown risks on animal health due to the presence of erucic acid and therefore the consumption has decreased globally. A review of technical opportunities to reduce erucic acid in mustard oil (canola oil has for examples versions with various level of erucic acid) would help assess the possibility in reintroducing mustard oil. Pakistan Institute of Development Economics (1993) research shows the shift of fat consumption pattern in Pakistan from desi ghee and mustard oil to vanaspati ghee and oil over the period of 1963-64 to 1990-91. It sheds light on the increase of vegetable ghee and oil consumption rise from 21% to 95% during that period.

Trait-enhanced oils generally fall into three categories:

- High-oleic acid oils, such as high-oleic sunflower and canola oils.
- Mid-range oleic acid oils, such as mid-oleic sunflower and soybean oils.
- 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.).

These types of oils are derived from traditional plant breeding or biotechnological methods. All of these trait enhanced oils have good oxidative stability making them suitable for frying, spraying, and for some bakery applications. These modification techniques offer the chance to minimise and control the trans content of oil blends and can be used to successfully formulate iTFA free hard stocks. Recent trends have indicated that many frying fats in the fast-food industry have been replaced by medium- and high-stability vegetable oils, resulting in a virtual elimination of iTFA in products fried with these fats.

For Pakistan this solution has limited application, as frying industry is focused on low price options i.e. palm oil, whereas the trait modified oils are expected to be more costly than palm oil. Moreover, no research activity on such trait modification of canola and sunflower seeds is under way in the local research institutions. The trait modified oil imported from elsewhere in the world at competitive prices would be the only option.

There are currently various popular options of raw material available for ghee and spread industry in Pakistan including palm oil, palm olein, other options are canola oil, sunflower oil, soybean oil, super palm olein, cottonseed oil, rapeseed oil.

Alternative oils could be corn oil, olive oil, rice bran oil and various palm oil fractions. In the view of some respondents, the search of alternatives is quite difficult, as all materials are already in use by ghee industry. It has also been suggested that rather than exploring the alternative raw materials it is better to alter the process to achieve desired goals of low iTFA product.
1. Executive summary

A report on sources and replacement solutions for iTFA in Pakistan
Mapping of industrially-produced Trans-fatty acids (iTFA) in Pakistan

1. Executive summary
6. Recommendations to replace iTFA

6.1 Provision of technical support to industries free of cost

In order to replace traditional products with high level of iTFA such as vanaspati ghee, more support should be provided to local companies – especially small and medium enterprises to support the identification and the implementation of feasible replacement solutions in the context of Pakistan. Both the international/national private sector and the public sector should work on providing:

- Training workshops on iTFA replacement focusing on:
  - Dry fractionation technology combined with blending of fractions
  - Enzymatic interesterification and chemical interesterification
  - Share information on the costs of implementing these replacement solutions for an individual company.

The technical assistance should also focus on oil and fat suppliers which should implement internal trainings for food processors, introducing various and latest healthier options.

6.2 Supporting consumer education on the health impact of iTFA consumption

A combination of public and public-private initiatives to inform consumers on iTFA health impact and support consumer demand for iTFA free products should be implemented. The brands having iTFA compliant products should clearly identified and used as examples for the rest of the industry in Pakistan. The brands with the lowest levels of iTFA could be selected for public private health campaigns. The consumer bodies, NGOs working in health sector, media, etc. should strive to increase the awareness of consumer regarding health hazards of trans fat.

Business to business initiatives should be implemented to increase the marketing skills of local Pakistani companies. This will enable local companies to implement effective marketing campaigns for their iTFA free products. Large companies with the relevant resources and expertise should prioritize their support based on iTFA content of the products from local companies.
6.3 Aligning regulations for imported and local products across the country

It is critical to see consistent regulations on iTFA in Pakistan to ensure that the industry faces a level playing field. Regulations should apply consistently in all provinces to both imported and domestically produced products. For example, the decision of the Punjab Food Authority to ban vanaspati ghee by 2020\(^2\) would need to lead to a national ban of vanaspati ghee to ensure better health impact and clarity for the industry.

These regulations should consider the current context of food production in Pakistan and suggest a timeline feasible for companies including small and medium enterprises. Additionally, regulations on iTFA level should ideally be complemented with the right enabling environment for iTFA elimination, for example by:

- Building laboratory capacity to assess iTFA content.
- Making the iTFA content lab assessment available with discounted prices for local small and medium enterprises.
- Introducing duties and taxes more favorable to iTFA free products. As indicated in the report, vegetable oils are mostly imported in Pakistan and healthier options are more expensive while Pakistan remains a lower middle income country, therefore the government can play a role in making healthier substitute to iTFA more affordable for both food manufactures and consumers.

6.4 Support demand for iTFA free products/compliant products

In procurement policies of public institutions (e.g. schools, hospitals, government offices, etc.) and in programs including those that provide supplemental nutrition to women and children, school nutrition programs, and any other projects supported by multi-government/public/international funds, a revision is required. Technical requirement of maximum iTFA content should be included in those procurement policies. The work should be carried out to replace iTFA in such products with healthy fat. Areas/ programs for target replacement include:

- School Nutrition Program
- Hunger Eradication Drives
- Disaster Relief Situations in country and outside country
- Armed Forces Supplies
- Hospital Meal Requirements
- Fortification Programs for Women and Adolescent

This will increase demand for iTFA compliant/free products and therefore incentivizes companies to invest rapidly in order to produce qualifying product for public sector entities.
1. Executive summary

A report on sources and replacement solutions for iTFA in Pakistan
1. Executive summary
### ANNEX

**Annexure I - Hydrogenation Processing Conditions in Pakistan**

<table>
<thead>
<tr>
<th>Processing Conditions</th>
<th>Temperature</th>
<th>Retention time</th>
<th>Catalyst</th>
<th>Oil used</th>
<th>Hydrogen pressure</th>
<th>Installed Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mill No. 1 Hamza</td>
<td>140-150°C</td>
<td>3-4 hrs</td>
<td>Ni, 0.013-0.03kg</td>
<td>Palm oil, Palm olein</td>
<td>1-2 bars</td>
<td>500MT/day</td>
</tr>
<tr>
<td>Mill No. 2 Unity 2</td>
<td>160°C</td>
<td>-</td>
<td>Ni</td>
<td>Palm olein</td>
<td>200 psi</td>
<td>100MT/day</td>
</tr>
<tr>
<td>Mill No. 3 Faisalbad</td>
<td>160°C</td>
<td>-</td>
<td>Ni</td>
<td>Palm olein</td>
<td>2 bars</td>
<td>100MT/day</td>
</tr>
<tr>
<td>Mill No. 4 Oil World</td>
<td>160-200°C</td>
<td>-</td>
<td>Ni</td>
<td>RBD Palm oil, Palm olein, Cotton seed oil, Soybean oil</td>
<td>1-2 bars</td>
<td>100MT/day</td>
</tr>
<tr>
<td>Mill No. 5 Al Madina</td>
<td>At 150°C Ni added, at 180°C H2 passes</td>
<td>8.5 hrs</td>
<td>Ni, 2kg for 14 MT at 25-40°C</td>
<td>55-65% RBD Palm oil, 35-45% Palm olein</td>
<td>200 psi for 4-5 hrs.</td>
<td>50MT/day</td>
</tr>
<tr>
<td>Mill No. 6 Ikram</td>
<td>NA</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>90MT/day</td>
</tr>
<tr>
<td>Mill No. 7 AB Oil</td>
<td>170-175°C</td>
<td>-</td>
<td>Ni</td>
<td>RBD Palm oil, Palm olein</td>
<td>-</td>
<td>100MT/day</td>
</tr>
<tr>
<td>Mill No. 8 Unity</td>
<td>No ghee production</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Mill No. 9 Razaq Basit</td>
<td>185-190°C</td>
<td>8 hrs</td>
<td>Ni</td>
<td>Palm olein</td>
<td>125 psi</td>
<td>100MT/day</td>
</tr>
<tr>
<td>Processing Conditions</td>
<td>Temperature</td>
<td>Retention time</td>
<td>Catalyst</td>
<td>Oil used</td>
<td>Hydrogen pressure</td>
<td>Installed Capacity</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------</td>
<td>----------------</td>
<td>----------</td>
<td>----------</td>
<td>-------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Mill No. 10 Dalda</td>
<td>Hydrogenation + Blending + Interesterification + Neutralization &amp; Bleaching + Deodorization</td>
<td>-</td>
<td>-</td>
<td>Palm oil 70% / Palm olein 20% / Canola 10%</td>
<td>-</td>
<td>1500 MT/ day</td>
</tr>
<tr>
<td>Mill No. 11 Agro Processing</td>
<td>160°C</td>
<td>Ni</td>
<td>Palm oil, Palm olein</td>
<td>1-2 bars</td>
<td>175 MT/ day</td>
<td></td>
</tr>
<tr>
<td>Mill No. 12 A&amp;Z Agro Industries</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mill No. 13 Habib Oil</td>
<td>Continuous process</td>
<td>Ni</td>
<td>RBD Palm oil, Palm olein, Cotton seed oil</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Mill No. 14 Wazir Ali</td>
<td>-</td>
<td>-</td>
<td>Ni</td>
<td>Palm oil, Soybean oil</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Mill No. 15 AI Madina</td>
<td>160°C</td>
<td>-</td>
<td>Ni</td>
<td>Palm oil, Palm olein</td>
<td>1-2 bars</td>
<td>-</td>
</tr>
<tr>
<td>Mill No. 16 Universal EOM</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mill No. 17 IFFCO</td>
<td>140°C</td>
<td>-</td>
<td>Ni</td>
<td>Palm oil, Palm olein</td>
<td>1-2 bars</td>
<td>1000 MT/ day</td>
</tr>
<tr>
<td>Mill No. 18 Shujabad Agro</td>
<td>Hydrogenation + Blending + Interesterification + Neutralization &amp; Bleaching + Deodorization</td>
<td>-</td>
<td>-</td>
<td>Palm oil, Palm olein, Super Olein, Soybean, Sunflower, Canola</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
### Processing Conditions Summary

<table>
<thead>
<tr>
<th>Processing Conditions</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temperature</strong></td>
<td>160°C, Range: 140-200°C</td>
</tr>
<tr>
<td><strong>Retention time</strong></td>
<td>8 hrs or continuous</td>
</tr>
<tr>
<td><strong>Catalyst</strong></td>
<td>Nickel, 0.013-0.03kg</td>
</tr>
<tr>
<td><strong>Oil used</strong></td>
<td><strong>Preferred:</strong> RBD Palm oil, Palm olein; <strong>Others:</strong> Cotton seed oil, Soybean oil, Canola oil</td>
</tr>
<tr>
<td><strong>Hydrogen pressure</strong></td>
<td>1-2 bars</td>
</tr>
<tr>
<td><strong>Installed Capacity</strong></td>
<td>Variable</td>
</tr>
<tr>
<td>Mill No.</td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
</tr>
<tr>
<td>1</td>
<td>Hamza</td>
</tr>
<tr>
<td>2</td>
<td>Unity 2</td>
</tr>
<tr>
<td>3</td>
<td>Faisalbad</td>
</tr>
<tr>
<td>4</td>
<td>Oil World</td>
</tr>
<tr>
<td>5</td>
<td>Al Madina</td>
</tr>
<tr>
<td>6</td>
<td>Ikram</td>
</tr>
<tr>
<td>7</td>
<td>AB Oil</td>
</tr>
<tr>
<td>8</td>
<td>Unity</td>
</tr>
<tr>
<td>9</td>
<td>Razaq Basit</td>
</tr>
<tr>
<td>Processing Conditions</td>
<td>Awareness with National Limits</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Mill No. 10 Dalda</td>
<td>Yes</td>
</tr>
<tr>
<td>Mill No. 11 Agro</td>
<td>No</td>
</tr>
<tr>
<td>Processing Industries</td>
<td></td>
</tr>
<tr>
<td>Mill No. 12 A&amp;Z Agro</td>
<td>No</td>
</tr>
<tr>
<td>Industries</td>
<td></td>
</tr>
<tr>
<td>Mill No. 13 Habib Oil</td>
<td>Yes</td>
</tr>
<tr>
<td>Mill No. 14 Wazir Ali</td>
<td>Yes</td>
</tr>
<tr>
<td>Mill No. 15 Al Madina</td>
<td>Yes</td>
</tr>
<tr>
<td>Mill No. 16 Universal</td>
<td>No</td>
</tr>
<tr>
<td>EOM</td>
<td></td>
</tr>
<tr>
<td>Mill No. 17 IFFCO</td>
<td>Yes</td>
</tr>
<tr>
<td>Mill No. 18 Shujabad</td>
<td>Yes</td>
</tr>
<tr>
<td>Summary</td>
<td>Yes : 10/18, No: 8/18</td>
</tr>
</tbody>
</table>
Annexure III - Companies interviewed

1. Hamza Vegetable Oil Refinery and Ghee Mills
2. Unity Foods Ltd
3. Faisalabad Oil Refinery
4. Oil World Pvt Ltd
5. Al-Madina Oil Mills Unit # 01
6. Ikram Yaqoob Ghee Ind.
7. Al-Hashmi Brothers Industries
8. Unity Foods Ltd
9. Razzaq Basit Oil Industries PVT LTD
10. Dalda foods Limited
11. Agro Processors & Atmospheric Gases (Pvt) Ltd
13. Habib Oil Mills
14. Wazir Ali Industries Ltd
15. Al-Madina Oil Industries
16. Universal TZ Oil Mills
17. IFFCO Pakistan
18. Shujabad Agro Industries (Pvt) Ltd.
19. Dalda Foods Limited
20. Novozymes A/S Liaison Office
21. Karamkimya
22. Cakes & Bakes
23. Sindh Dairy & Breeding Farm
24. Malaysian Palm Oil Board (MPOB), Pakistan
25. Karachi association of Sweets and Nimco
26. Bhaya Food
27. Merit Bread Pvt. Ltd.
Annexure IV - Industrial Trans Fat

Questionnaire

This questionnaire collects 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 ghee).

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 texturizers (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 Pakistan

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Fast food</th>
<th>Supermarket products</th>
<th>Fats and oils</th>
<th>Breakfast foods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baked goods (biscuits, pastries and cake)</td>
<td>Biscuits</td>
<td></td>
<td>Vanaspati ghee</td>
<td>Doughnuts</td>
</tr>
<tr>
<td>Fried foods (fries, doughnuts)</td>
<td>Wafers</td>
<td></td>
<td>Shortening</td>
<td>Poori</td>
</tr>
<tr>
<td></td>
<td>Baked goods</td>
<td></td>
<td>Partially hydrogenated oils</td>
<td>Pratha</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Margarines</td>
<td>Cake</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Puff pastry</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Biscuits</td>
</tr>
</tbody>
</table>
RESPONDANT'S PARTICULARS

Name _____________________________________________________________

Designation _____________________________________________________________

Company _____________________________________________________________

Address _____________________________________________________________

Phone Number _____________________________________________________________

Email _____________________________________________________________

1) Question for all

Do you know what industrial trans fat is?

کیا آپ جانتے ہیں کہ صنعتی ٹرانس فیٹ کیا ہے؟

2) Questions for Oil and Ghee 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.)?

آپ کون سے اجزاء / خام مال عام طور پر اپنی مصنوعات کی تیاری میں استعمال کرتے ہیں (تیل،گھی،سپریڈ وغیرہ میں)?

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

آپ کے خام مال کے انتخاب پر اثر انداز ہونے والی عوامل کیا بہت ہیں؟

3) Additional questions based on previous responses

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

کونے اجزاء کو استعمال کرتے ہیں کہ طور پر آپ کے مکمل اجزاء کا استعمال کیا بہت ہیں؟

1) Question for all

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کیا آپ جانتے ہیں کہ صنعتی ٹرانس فیٹ کیا ہے؟

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کونے اجزاء کو استعمال کرتے ہیں کہ طور پر آپ کے مکمل اجزاء کا استعمال کیا بہت ہیں؟

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.

اگر آپ اپنے خام مال اجرا کے طور پر بدلیلی ہیں تو ممکنہ طور پر اخراجات (قیمت میں) کیا بدلیلی آۓ گی؟

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

اگر آپ اپنے خام مال اجرا کے طور پر بدلیلی ہیں تو ممکنہ ہیں کہ تکنیکی اثرات پیدا ہوسکتے ہیں؟ (پیداوار لائن میں تبدیلیاں، پکیجنگ کی ضرورت وغیرہ)

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)

آپ کے پسندیدہ متبادل اجزاء کے علاوہ آپ کی مصنوعات کی لائنز کے لیے دوسرے متبادل اجزاء کی اثرات پر مصنوعات کی ذائقہ، پر اثرات، جو دستیاب متبادل کے استعمال کو محدود کرسکتے ہیں۔

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)

کیا آپ اپنے مصنوعات کی تیاری کا عمل بالائی گر سکتے ہیں، پر اسٹیکس وقت، درجہ حرارت، دیاگ، دستیابی، درجہ حرارت اور دیاگ میٹر
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)

کیا آپ وضاحت کر سکتے ہیں کہ آپ کی تنظیم/فیکٹری میں تیل کی ہائڈروجینیشن کے لئے کیا کام کیا ہے؟ پروسیسنگ وقت، کادیٰل، درجہ حرارت، تیل کی اقسام، تیل کا تناسب، بائینریووجین دباؤ ہے؟

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

کیا آپ کے پاس مصنوعات کی پروسیسنگ کے لئے SOP موجود ہیں؟

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

آپ کی فیکٹری کی پیداواری صلاحیت ہے اور موجودہ آپریٹنگ صلاحیت ہے؟

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

کیا آپ کے نظریہ آپ کی مصرف کے لئے صحت مند ٹرانس فیٹ کی جگہ اپنے ٹرانس فیٹ کی جگہ متبادل فراہم کرنے کے لئے حوصلہ افزائی کی؟

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

کیا آپ کی مصنوعات غذائیت کی معلومات کے ساتھ پکا ہیں؟ (اگر غذائیت کی لیبلنگ موجودہ ہے تو ٹرانس فیٹ کی سطح پر فراہم کر کے معلومات؟)

4) Questions for Food Processors

Core questions

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

کیا آپ کی مصنوعات میں استعمال ہونے والی تیل اور بیکنگ مارجرین کے لئے کیا کام کیا ہے؟

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?

کیا آپ اس فہرست میں سے اپنی سیلائرز سے میا کردا ہے؟ مصنوعات کی نوعیت بیان کر سکتے ہیں: کیک، بسکٹ، سندوچ یا بیکنگ مارجرین، بیکری کے مصنوعات، مارجرین، وناسپتی گھی اور غیرہ؟

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

کیا آپ ٹرانس فیٹ کی جگہ اپنے صارفین کے لئے صحت مند ٹرانس فیٹ کی جگہ اپنے ٹرانس فیٹ کی جگہ متبادل فراہم کرنے کے لئے سرمایہ کاری کرنا چاہتے ہیں؟

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

کیا آپ کی مصنوعات میں کس اینٹی ٹرانس فیٹ پر قومی سفارشات سے آگاہ ہیں؟
Additional questions based on previous responses

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

آپ کی مصنوعات کو پتھر بنانے کے لئے آپ کی کمپنی کے اندرون صلاحیتیں موجود ہیں، اور آپ مصنوعات کو پتھر کرنے کی ضرورت ہے؟

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

آپ کی کمپنی کے لئے ٹرانس فیٹ کی کمی یا خاتمے کی ممکنہ نتائج کی یقینی؟

If there were 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)?

اگر آپ کو آپ کی مصنوعات سے ٹرانس فیٹ پر قومی سفارشات سے آگاہ پڑے تو آپ کو کس طرح ممکنہ موجودہ پتھر بنانے کی مشکلات کا سپلائرز تک رسائی؟

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)

اگر آپ کو پتھر بنانے کی ضرورت پڑتا ہے تو آپ کی کمپنی کو موجودہ پتھر بنانے کی مشکلات کا سپلائرز تک رسائی؟

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

کیا آپ اپنی ملک میں ٹرانس فیٹ پر قومی سفارشات سے آگاہ ہیں؟

5) Questions for Experts and for Companies that have Role to Replace Industrial Trans Fat

What improved technologies are you offering for oil, shortening or margarine processing?

کیا آپ کو ٹرانس فیٹ پر قومی سفارشات سے آگاہ پڑے تو آپ کو کس طرح ممکنہ موجودہ پتھر بنانے کی مشکلات کا سپلائرز تک رسائی؟

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

کیا آپ کو پتھر بنانے کی ضرورت پڑتا ہے تو آپ کو کس طرح ممکنہ موجودہ پتھر بنانے کی مشکلات کا سپلائرز تک رسائی؟

Do you have a laboratory along required manpower within your company/organisation to conduct industrial trans fat analysis?

کیا آپ کو پتھر بنانے کی ضرورت پڑتا ہے تو آپ کو کس طرح ممکنہ موجودہ پتھر بنانے کی مشکلات کا سپلائرز تک رسائی?

What measures are in place at your company’s marketing section to encourage consumers to make healthier choices with regards to industrial trans fat?

کیا آپ کو پتھر بنانے کی ضرورت پڑتا ہے تو آپ کو کس طرح ممکنہ موجودہ پتھر بنانے کی مشکلات کا سپلائرز تک رسائی?

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

کیا آپ کو پتھر بنانے کی ضرورت پڑتا ہے تو آپ کو کس طرح ممکنہ موجودہ پتھر بنانے کی مشکلات کا سپلائرز تک رسائی?

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

کیا آپ کو پتھر بنانے کی ضرورت پڑتا ہے تو آپ کو کس طرح ممکنہ موجودہ پتھر بنانے کی مشکلات کا سپلائرز تک رسائی?

How do you assess, the enforcement procedures in place or will be needed to ensure the elimination of trans fats in Pakistan? Also, describe the conditions under which TFA claims are permitted on products.

کیا آپ کو پتھر بنانے کی ضرورت پڑتا ہے تو آپ کو کس طرح ممکنہ موجودہ پتھر بنانے کی مشکلات کا سپلائرز تک رسائی?

What type of capacity building training on industrial trans fat replacements currently exist or could be provided to industry people/ regulatory body staff?

کیا آپ کو پتھر بنانے کی ضرورت پڑتا ہے تو آپ کو کس طرح ممکنہ موجودہ پتھر بنانے کی مشکلات کا سپلائرز تک رسائی?

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?

کیا آپ کو پتھر بنانے کی ضرورت پڑتا ہے تو آپ کو کس طرح ممکنہ موجودہ پتھر بنانے کی مشکلات کا سپلائرز تک رسائی?

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

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