

# Quality Assessment of Fortified Edible Oil Samples from the Open Market

## A RESEARCH REPORT

# Quality Assessment of Fortified Edible Oil Samples from the Open Market - A Research Report

## Publisher

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## INTRODUCTION

In its drive to promote the reduction of micronutrient deficiencies in the general population, the Government of India has been advocating for micronutrient fortification of foods. The Government has gazetted standards for the fortification of edible oil and milk with Vitamin A and Vitamin D; of rice and wheat flour with iron, folic acid and Vitamin B12; and of salt with iron and iodine. Regardless of whether Vitamin A occurs naturally or has been added to a food product through fortification or other means, there is potential for loss by chemical or physical means. These losses may also occur due to exposure to light and heat exposure, resulting in oxidation (Butt et al., 2007). Retention of Vitamin A, especially in fortified foods, is important for determining the efficacy of fortification programs. Several studies have reported losses in Vitamin A concentration when fortified oil was exposed to sunlight. While the fortification of staple foods with micronutrients has been proven to improve the nutritional status of population and to be cost-effective, it is often implemented and delivered sub-optimally, thereby limiting its potential for impact.<sup>5</sup> KHPT and GAIN conducted a market fortification assessment during December 2020-April 2021 across eight states to understand more completely the quality of fortification. The objectives of the study were to: (a) identify locally produced fortified edible oil types and variants available in the open market and establish whether they meet fortification standards for Vitamin A and D as prescribed by the Food Safety and Standards Authority of India (FSSAI); (b) examine the co-relation between the addition of anti-oxidant in edible oils and the stability of Vitamin A and (c) examine the co-relation between peroxide value and the stability of Vitamin A.

<sup>1</sup>Butt MS, Arshad MU, Alam MS, Nadeem MT (2007). Bioavailability and storage stability of vitamin A fortificant (retinyl acetate) in fortified cookies. *Food Res. Int.* 40:1212-1219

<sup>2</sup>Chimimba et al. (2016). Vitamin A losses in a commercial food supply chain of fortified vegetable cooking oil and maize flour: A case from Malawi. *African Journal of Food Science*. Vol. 10(11) pp. 297-301.

<sup>3</sup>Horton, S (2006). The economics of food fortification. *Journal of Nutrition*. 136, 1068–1071.

<sup>4</sup>Allen, L.H.; De Benoist, B.; Dary, O.; Hurrell, R (2006). *Guidelines on Food Fortification with Micronutrients*; World Health Organization, Geneva, Switzerland.

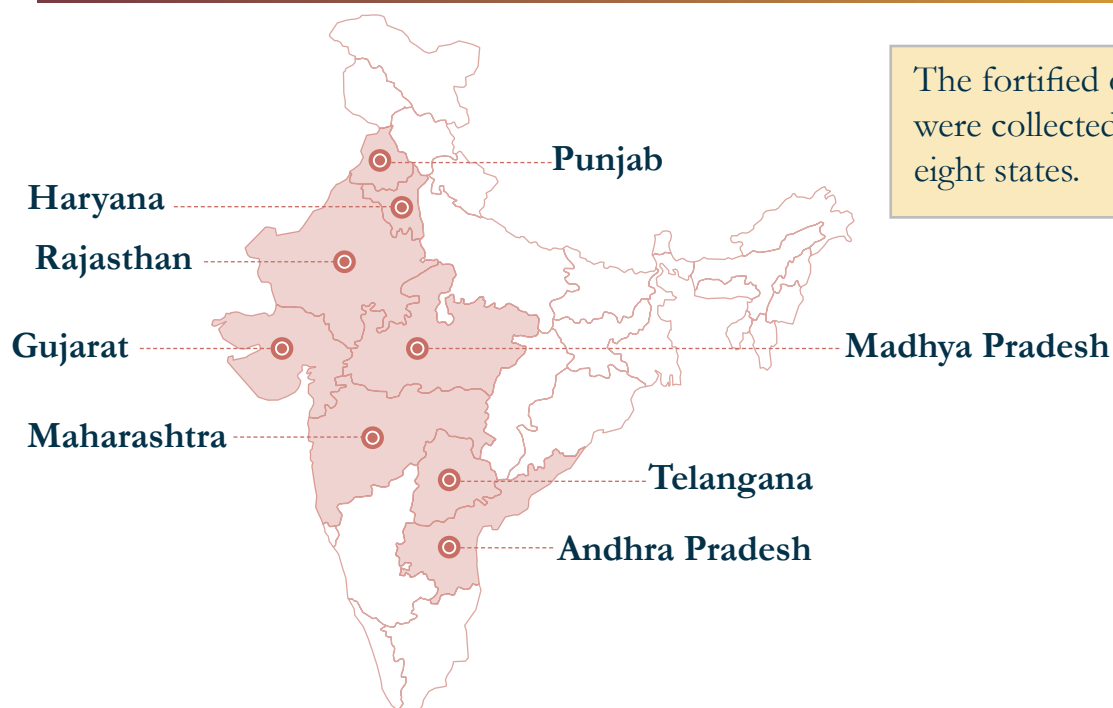
<sup>5</sup>Aaron, G.J.; Friesen, V.M.; Jungjohann, S.; Garrett, G.S.; Neufeld, L.M.; Myatt, M (2017). Coverage of Large-Scale Food Fortification of Edible Oil, Wheat Flour, and Maize Flour Varies Greatly by Vehicle and Country but Is Consistently Lower among the Most Vulnerable: Results from Coverage Surveys in 8 Countries. *Journal of Nutrition*.



# MATERIALS AND METHODS



## Geography



## Design and sampling



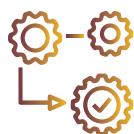
A state-wise breakup of fortified oil brands was finalized based on the verified number of industries and brands reported as fortified brands in an oil industry monitoring sheet maintained by KHPT-GAIN. Details of only those industries which have received substantial technical support from GAIN and its current and former implementation partners (KHPT, IIHMR, Vatsalya and CECOEDECON) were considered. Among them, brands of edible oil which are fortified with Vitamin A and Vitamin D only (as per FSSAI standards) were included in the list. Based on the list, the sampling strategy was planned with a maximum limit of **250** fortified oil samples to be analyzed. A sample collection checklist form was also prepared to fill all the relevant details and information about the fortified oil sample being picked up.



## Inclusion criteria for fortified oil samples to be collected

The total number of fortified brands identified from the monitoring sheet shared by GAIN was about **495** across the eight states. The following sampling criteria were followed until the maximum sample size (**250**) was achieved:

Level	Inclusion Criteria	Sub-criteria
<b>STEP 1</b>	All the oil industries with single brand or variant	One fortified oil sample from each industry
<b>STEP 2</b>	Oil mills with more than one brand and variant	<p>Samples to be picked based on type of processing-</p> <p>a. One fortified refined oil sample</p> <p>b. One fortified cold pressed/filtered oil sample (e.g. Kacchi Ghani), if available.</p> <p>c. One fortified blended oil sample, if available.</p>



## Sample collection guidelines

- Sample collection was directly done by the project staff (state leads) from the market as per sample collection guidelines.
- Samples were collected/purchased from the open retail market only.
- The sample collection checklist form was filled for each sample.
- Only fortified edible oil available in retail packs (Preferably **500 ml** and/or **1 L** pouch/pet bottle-properly sealed) were collected.
- The nutrition panel for each sample was examined. Samples with printed values of Vitamin A between **600 mcg RE-990 mcg RE per 100 g** of oil and of Vitamin D between **11 mcg-16 mcg per 100 g** of oil on their labels were considered.
- The most recent manufacturing date of samples was considered. Only samples with a packaging date within the previous 2 months were selected for analysis.





## Selection of laboratory for analysis

KHPT-GAIN have the experience of working with a leading analytical NABL-accredited laboratory, namely TUV SUD South Asia Pvt. Ltd., in Bengaluru, Karnataka for the analysis of fortificants in fortified food samples. All the samples collected from the open market across project intervention states were sent only to this laboratory for the analysis.



## Analysis of Vitamins A and D and peroxide value

All the fortified oil samples collected were sent to the laboratory for the quantitative analysis of Vitamin A and D, as well as for the peroxide value. The following important points were considered while dispatching the samples:

- Samples in the original packaging were placed in a clean, inert box/packet, providing secure protection from contamination, damage and leakage.
- Dark-coloured boxes/ packets were used so as to prevent light-based degradation of vitamins.
- The boxes were properly sealed and a test request form for the analysis was attached with the sample.



## Impact analysis of added antioxidant and peroxide value on stability of Vitamin A

Samples with and without added antioxidants were compared for the Vitamin A concentrations based on the reports received from the laboratory, in order to examine the relationship between the presence of antioxidant and stability of Vitamin A in the oil. Test results were also compared to examine if there was any co-relation between peroxide value of the oil and stability of Vitamin A.





## Limitations of the study

- During the visits to the open market, we found limited or no availability of a few samples. Many of the industries had either stopped or temporarily halted the production of fortified oils. Few industries were found to have closed permanently during the lockdown. Based on these observations, we collected fortified oil variants other than those selected to ensure a significant sample size.
- Due to reduced production during the lockdown period, getting samples from fresh batches was not possible in some cases. We had to pick up samples where the date of packaging was 4 months prior to the dates of sample pickup.
- KHPT had started to work with a list of industries shared with GAIN by its previous implementation partners before the COVID-19 pandemic. There were some significant changes in all the states during and after the COVID-19 lockdown in 2020. Our sample size and list of selected brands were affected largely by this.
- Fortified oil samples could not be collected as targeted, especially from the states of Punjab and Haryana, because of the farmer protests and border closures. Only three out of six samples from Punjab and one out of 10 from Haryana were collected from local markets in Delhi.

## RESULTS



### Presence/availability of edible oil brands in the market

Based on the list provided by GAIN and its previous implementation partners, a total of **239** samples were set as a target for pick-up. Out of those **239** samples, **144** edible oil samples were collected across eight states during the study period. The state-wise details of samples are presented in **Table 1**. The remaining **95** samples could not be picked up due to various reasons, such as not being available in the local market and/or in retail pack sizes of 500 ml or 1 litre.

State	Number of samples selected	Number of samples collected
Gujarat	61	35
Maharashtra	27	23
Rajasthan	84	34
Madhya Pradesh	19	19
Andhra Pradesh	28	25
Telangana	4	4
Punjab	6	3
Haryana	10	1

Table 1: Number of edible oil brands selected and collected across states

## Types of edible oil collected from the market

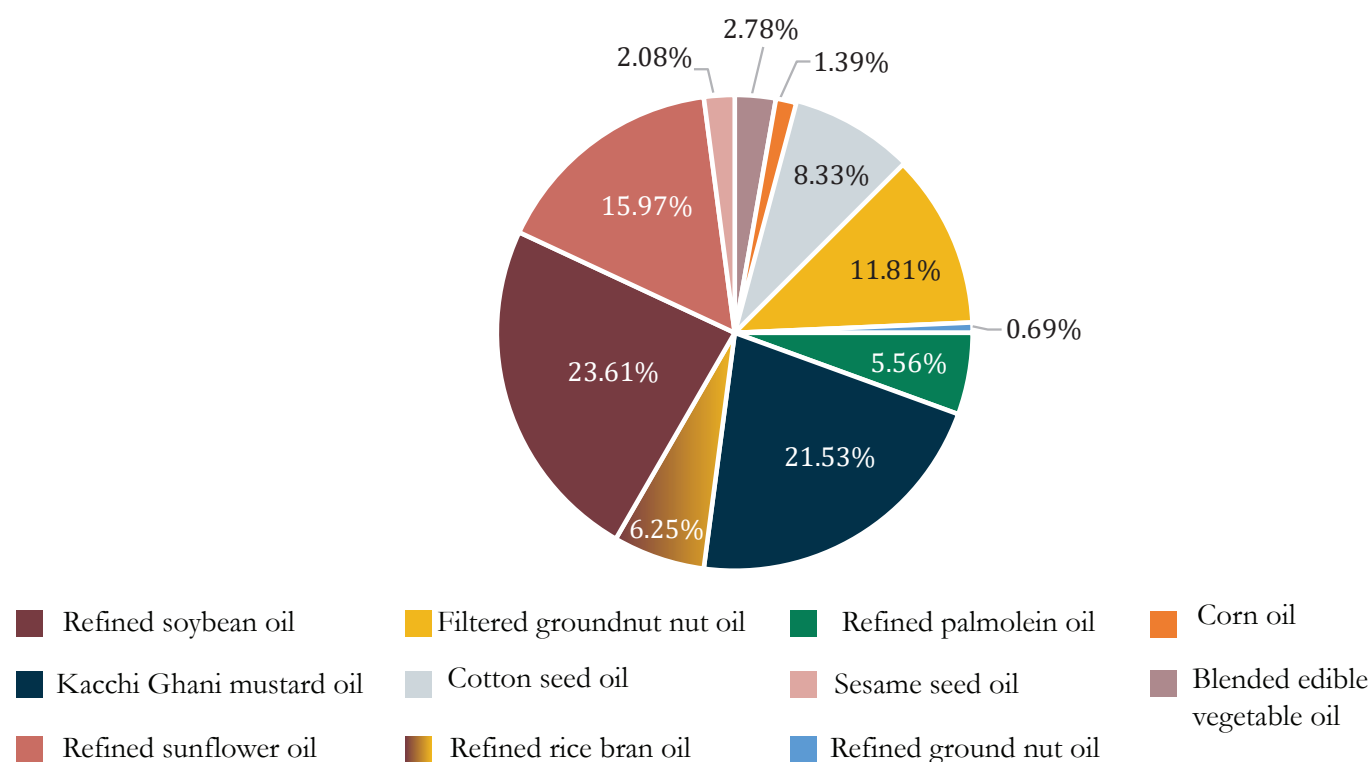


Figure 1: Oil variants collected from the open market

Of the 144 edible oil samples collected, most (23.61%) were refined soybean oil followed by mustard oil (21.53%), refined sunflower oil (15.97%), filtered groundnut oil (11.81%), refined cottonseed oil (8.33 %), refined rice bran oil (6.25 %), refined palmolein oil (5.56%), blended edible vegetable oil (2.78 %) and sesame seed oil (2.08 %), refined corn oil (1.39%) and refined groundnut oil (0.69 %). The percentage share of various types of edible oils being sold in the open market is represented in Figure 1.

## Standards for fortification in collected edible oil samples

Currently, the fortification of edible oil is being carried out in the country using mainly two different standards prescribed by the FSSAI. Operationalized standards were released in 2016, according to which measurement units for both Vitamins A and D need to be mentioned in IU on the packs, whereas gazetted standards were released by the FSSAI in 2018, according to which measurement units of Vitamin A should be mentioned as mcg RE (micrograms Retinol Equivalent) and Vitamin D as mcg (micrograms). Ideally, the industries using operationalized standards must switch now to gazetted standards in terms of mentioning mcg RE units on their packaging.

From the observations, it was reported that **11** samples were found to still be following the 2016 operational standards and mentioning IU units for both the added vitamins on their labels. The states in which industries are still using operationalized standards are Rajasthan, Maharashtra and Madhya Pradesh. Efforts are required to ascertain the reason for the delay in adoption of gazetted standards in these geographies.

State	Samples using mcg RE and mcg as measurement units for Vitamin A and Vitamin D respectively	Samples using IU as measurement unit for added Vitamins A and D	Incomplete Information on the Pack
Rajasthan	28	5	1
Maharashtra	20	3	0
Andhra Pradesh	24	0	1
Telangana	4	0	0
Punjab	3	0	0
Haryana	0	1	0
Madhya Pradesh	17	2	0
Gujarat	35	0	0
<b>Total</b>	<b>131</b>	<b>11</b>	<b>2</b>

Table 2: Standards for fortification in collected edible oil samples

## State-wise distribution of oil samples and their fortification quality

Of the **144** samples collected, only **43** samples were found to be as per gazetted standards of FSSAI. Out of **101** samples not compliant with standards:

- 1** **55** oil samples were fortified below the minimum prescribed levels of Vitamin A and D
- 2** Both vitamins A and D were not detected at all in **41** oil samples
- 3** Either of the vitamins were detected in **2** samples
- 4** Vitamin A concentrations were found to be exceptionally high in **3** samples.

State	Samples collected	Samples as per standards	Samples below the limit of quantification or less than prescribed for both the vitamins	Samples higher than range	Vitamins Not Detected	Any one vitamin detected
Gujarat	35	8	11	0	16	0
Maharashtra	23	5	16	0	2	
Rajasthan	34	3	4	3 (A high, D absent)	22	2
Madhya Pradesh	19	10	9	0	0	0
Andhra Pradesh	25	12	13	0	0	0
Telangana	4	2	2	0	0	0
Punjab	3	3	0	0	0	0
Haryana	1	0	0	0	1	0
<b>Total</b>	<b>144</b>	<b>43</b>	<b>55</b>	<b>3</b>	<b>41</b>	<b>2</b>

Table 3: State-wise distribution of oil samples and their fortification quality

## Fortification quality and oil variants

Out of all samples analysed, on the basis of oil variants, it has been reported that mostly kacchi ghani oil samples (**N=29**) did not conform to FSSAI quality standards, followed by refined soybean oil (**N=17**), filtered groundnut oil (**N=14**), and refined sunflower oil (**N=13**).

The resulted are represented in the table below:

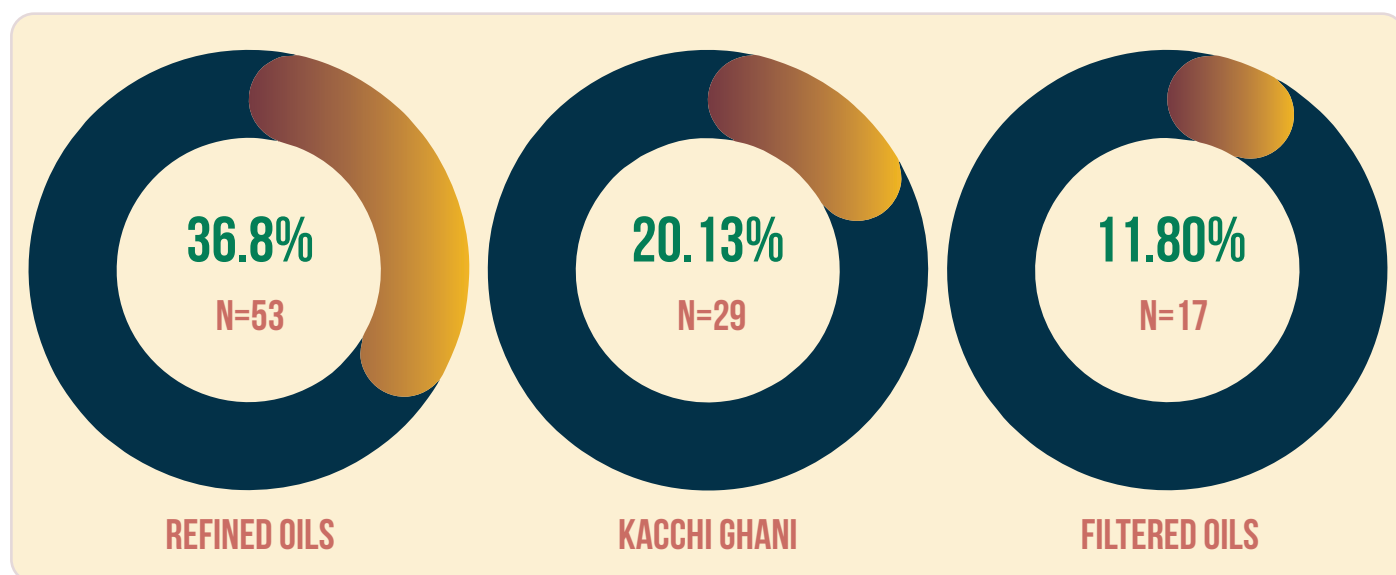
Oil variants	Compliant with FSSAI standards	Not compliant with FSSAI standards
Blended edible oil	2	2
Corn oil	1	1
Cotton seed oil	2	10
Filtered ground nut oil	3	14
Refined ground nut oil	0	1
Refined palmolein oil	1	7
Kacchi ghani mustard oil	2	29
Refined rice bran oil	5	4
Refined soybean oil	17	17
Refined sunflower oil	10	13
Sesame seed oil	0	3
<b>Total</b>	<b>43</b>	<b>101</b>

Table 4: Fortification quality and oil variants



## Fortification quality and type of oils

Out of all samples analysed, the following proportion failed to conform to the prescribed standards for level of both the vitamins:



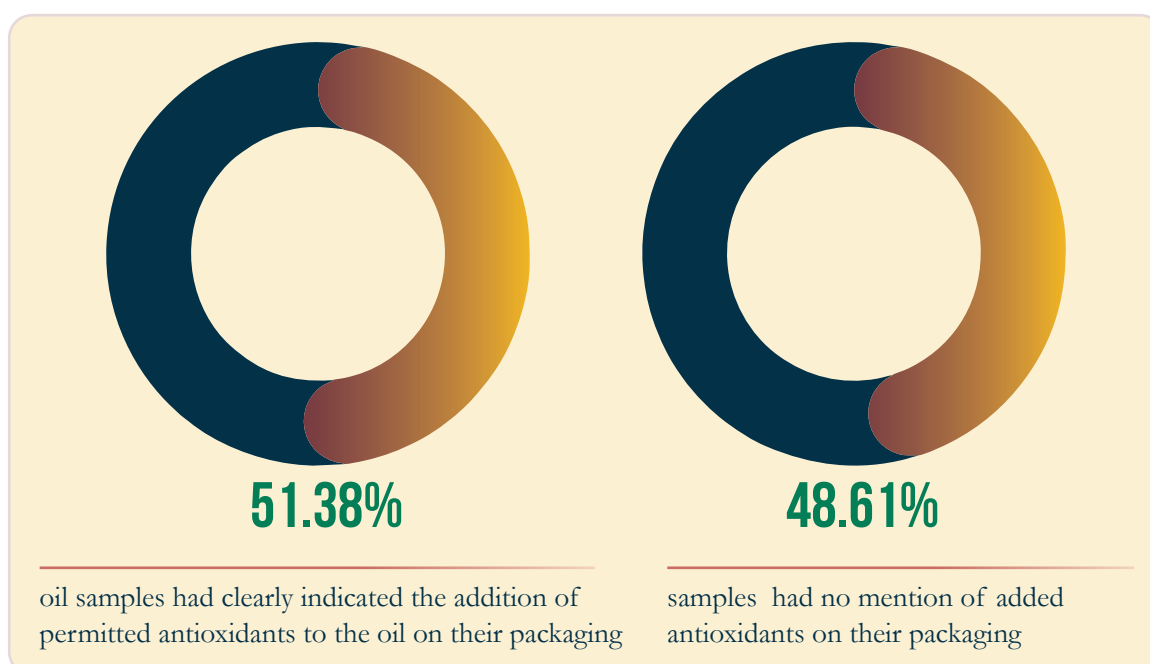
The results are represented in the table below:

Type of oil	Compliant with FSSAI standards	Not compliant with FSSAI standards
Filtered oils	3	17
Refined oils	36	53
Kacchi ghani	2	29
Blended oils	2	2
Total	43	101

Table 5: Fortification quality and type of oils

## Antioxidant addition status

Of the total oil samples collected from open market:



State-wise details of oil samples with added antioxidants are represented in the table below.

Number of Industries indicating the addition of Antioxidants to their Oils on their Packaging		
State	Yes	No
Rajasthan	3	31
Maharashtra	11	12
Madhya Pradesh	15	4
Andhra Pradesh	18	7
Telangana	4	0
Punjab	2	1
Haryana	0	1
Gujarat	17	18
<b>Total</b>	<b>70</b>	<b>74</b>

Table 6: Antioxidant addition status in collected samples

## Packaging and labelling regulations with respect to fortification

In terms of packaging and labelling regulations, most of the samples have reported compliance with the basic mandatory modifications in the packaging with respect to fortification. Of all **144** samples, **141** samples had the + F logo on their packaging; **143** samples had mentioned added values of Vitamins A and D on the nutrition panel of their packaging, and **141** samples had mentioned Vitamins A and D in their ingredient list as well. However, from our observations, it is very clear that edible oil industries are less interested or not interested in optional packaging modifications, i.e. mentioning the nutrition claims on their packaging. More effort may be required to sensitize the industries to use these nutrition claims on their packaging, as this may serve as a unique selling proposition (USP) for their products.



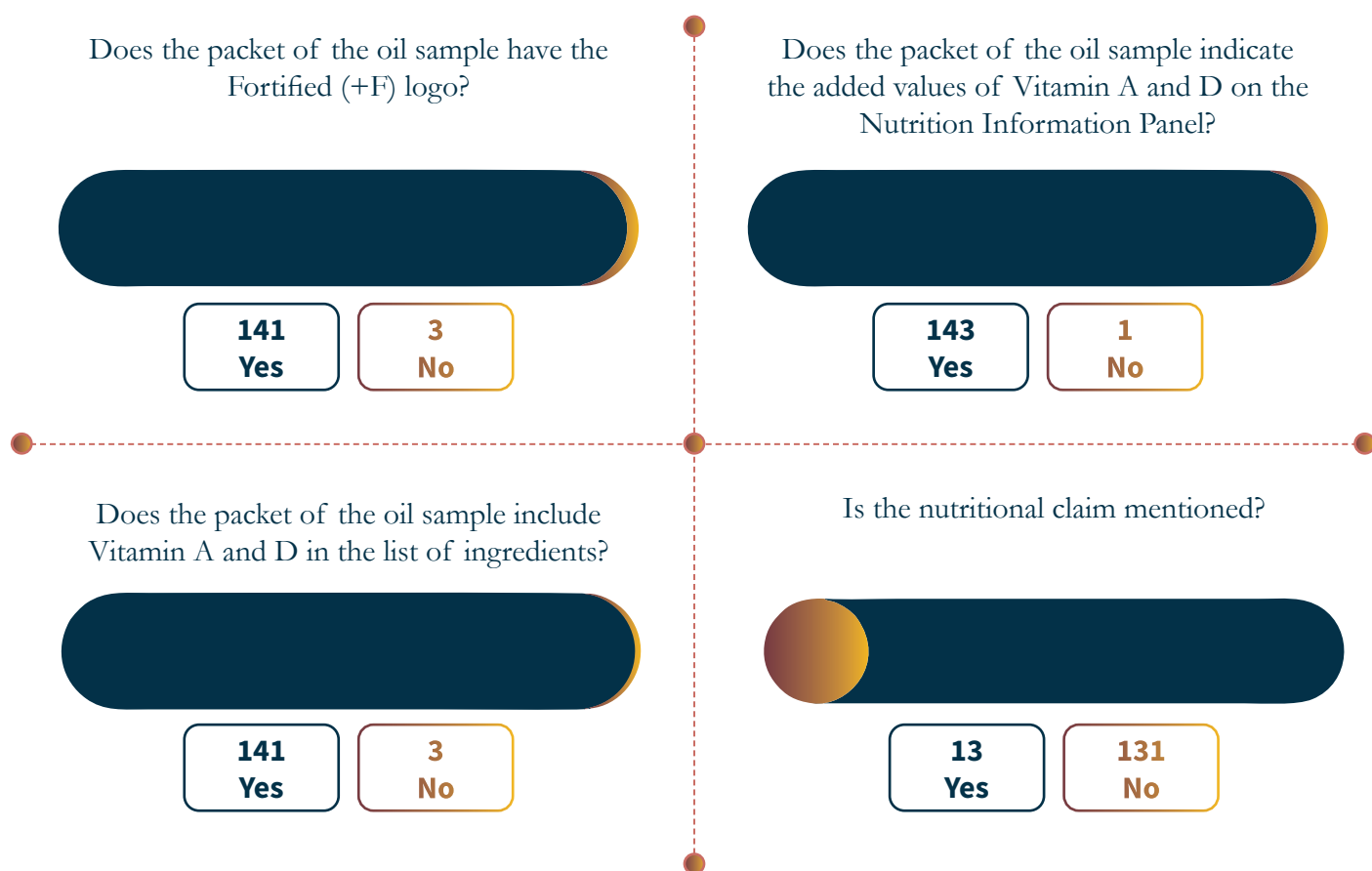


Table 7: Packaging and labelling regulations with respect to fortification

## Impact analysis of added antioxidant and Vitamin A concentrations in the oil samples

Of the **74** edible oil samples with added antioxidants, levels of Vitamin A could not be detected in eight samples; **2** had levels below the limit of quantification; **33** oil samples were reported to have levels below the prescribed or mentioned values of Vitamin A, and **31** samples were found to comply with standards. Of the **70** edible oil samples which did not have added antioxidants to their products, levels of Vitamin A could not be detected in **34** samples; **2** samples showed levels below the limit of quantification; **17** edible oil samples showed levels of Vitamin A below the prescribed or mentioned values; **14** samples were found to have levels of Vitamin A in compliance with the standards and **3** samples were found to have exceptionally high levels of Vitamin A.

From the test reports, it is clear that in **34** edible oil samples fortified with Vitamins A and D, but with no addition of antioxidants, levels of Vitamin A could not be detected at all. The added Vitamin A may have performed its antioxidant action, thus attributing its loss in the samples. Storage conditions and temperature are very important factors contributing to the loss of Vitamin D in edible oil samples. In a study<sup>6</sup> conducted by Hemery et al. (2015), it has been found that fortified soybean oil, when packed in transparent pet bottles and exposed to natural light, may have lost up to **60-68 %** of Vitamin D. Surprisingly, out of those **34** samples, **25** samples were of kacchi ghani mustard oil, which is an unrefined oil and more susceptible to oxidation. In contrast, of the **8** samples with added antioxidants and no detection of either Vitamin A or D, **7** samples were refined oils. Here, the reason could be storage and transportation conditions of those particular samples or errors while testing from the laboratory's end.

<sup>6</sup>Y.M. Hemery et al. (2015). Influence of light exposure and oxidative status on the stability of vitamins A and D3 during the storage of fortified soybean oil. Food Chemistry 184: 90–98

Levels of Vitamin A in the Lab Test Reports	Added Antioxidants (N=74)	Without Antioxidants (N=70)
Not detected at all	8	34
Levels below the limit of quantification	2	2
Levels below the prescribed or mentioned values	33	17
Levels as per the standards	31	14
Levels exceptionally high	0	3

**Table 8:** Impact of added antioxidant and vitamin a concentrations of the oil samples

## Peroxide value of edible oil samples

The maximum peroxide value measured was **3.4 meq oxygen/kg** in one of the kacchi ghani oil samples, which was lower than the standard maximum. Out of **74** samples with added antioxidants, **68** samples had a peroxide value of less than **0.5 meq oxygen/kg**, whereas out of **70** samples without added antioxidants, **59** samples showed a peroxide value of less than **0.5 meq oxygen/kg**. The rest of the samples also reported values lower than the standard maximum. The quantitative analyses of oil samples had shown that addition of antioxidants to the oils does not have any significant impact on peroxide value of oils.

## SUMMARY OF FINDINGS

- A large proportion of fortified brands have been found non-compliant with FSSAI standards for the presence of Vitamin A and D. Among them, results from the refined oil category are better than other categories, i.e. 25% of refined oils have been found to be compliant with FSSAI standards. This indicates that large industries which produce refined oil have better technical capabilities and resources in comparison with MSME industries, which mostly produce filtered and other category oils.
- The non-compliance of a large number of industries to fortificant standards across geographies indicates many possible reasons to be explored further, including the quality of premix being used, laboratory protocols followed to assess levels of fortificants etc., in addition to the fortification procedures being followed by industries themselves.
- Generally, a large proportion of samples of filtered oil (kacchi ghani) have reported not adding antioxidants. At the same time, a high proportion of these brands have either shown no presence or a sub-optimal presence of Vitamins A and D. This again establishes the relation between anti oxidants and the presence of Vitamins A and D.
- The peroxide value levels of all oil samples have been consistently within permissible range across all samples. This is surprising, as a large proportion of samples were found to be non-compliant with fortification standards, given the established relationship between peroxide value and levels of fortificants in edible oil. This points to the need for further evaluation of laboratory methods followed in assessing the peroxide levels and fortificant levels.





## CONCLUSIONS

This market assessment revealed that most of the packaged fortified oil brands have reported either low or no addition of fortificants. The study also showed that many of the brands were not available in the local geographies where they are being produced and, if available, only pack sizes of more than 5 kgs were available, which were beyond the sample inclusion criteria of this assessment study. This market assessment aims to fill an information gap by identifying different oil types and variants that do or do not meet the fortification standards and should be followed up through further investigation or inspections to initiate corrective action.

## RECOMMENDATIONS

- Strengthen quality of the fortification process followed at the industry level. A comprehensive capacity building process incorporating all aspects of fortification should be developed and implemented.
- The quality assessment of premix being used in the fortification process needs to be strengthened.
- The fortificant evaluation protocols followed at the laboratories, as well as methods to evaluate peroxide value, need to be evaluated and strengthened.
- The food safety department quality assurance process needs to be expanded and strengthened.
- There is a need to encourage industries following operationalised standards of 2016 to adopt gazetted standards of FSSAI 2018.

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**Range:** Operationalised standards (OS) - Vitamin A (25 IU/G) and Vitamin D (4.5IU/G)  
New standards(NS) - (Vitamin A: 6 µg RE- 9.9 µg RE per G and Vitamin D: 0.11 µg-0.16 µg per G)

**Range:** Operationalised standards (OS) - Vitamin A (25 IU/G) and Vitamin D (4.5IU/G)







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