

Interim Report

National Milk Safety and Quality Survey, 2018

13th November, 2018

1.0 Introduction

Public confidence in the safety and quality of milk and milk products is adversely affected due to frequent reports / messages appearing in the media including social media in recent past, highlighting large scale adulteration of milk and milk products in the country. As country's food safety regulator, the Food Safety and Standards Authority of India (FSSAI) is expected to take cognizance of expression of such public concerns and take preventive / corrective measures in close cooperation with the State food safety authorities.

In 2011, FSSAI had conducted a quick survey of adulteration of milk through its regional offices. This quick survey suffered from several drawbacks that included lack of harmonized protocols for sample collection and analysis, testing done in un-accredited laboratories, lack of data on the sectoral details of organized and unorganized sector and types of milk (buffalo milk, cow milk, mixed-milk, toned-milk, double toned milk, standardised milk, full cream milk, etc.). The survey was based on 1791 samples and focussed mainly on quality parameters rather than safety concerns. Only qualitative analysis was done and the survey did not include parameters related to contaminants. Another milk survey was attempted in 2016 through State food authorities. This survey also suffered from similar infirmities.

In light of experience above, FSSAI took up a large scale survey on safety and quality of milk in the country in 2018. In order to ensure that the survey uses uniform test protocols both for sampling as well as analysis, FSSAI entrusted this survey to reputed accredited laboratory with pan-India presence. On-the-spot qualitative analysis of milk was done to avoid any error and maintain traceability of sampling and analysis. An effort was made to identify hot-spots for possible contaminants / adulterants.

Referred to as '*National Milk Quality Survey, 2018*', this survey is by far the largest in terms of sample size (6432 samples qualitatively analysed) and largest numbers of parameters (4 quality parameters, Fat, SNF, Protein and added water; 12 adulterants; and 4 contaminants – antibiotics, pesticides, Aflatoxin M₁ and Ammonium Sulphate). In addition, those samples that failed in the qualitative tests were quantitatively analysed for various contaminants / hazards. Further, geo-tagging of samples and photo-documentation of samples were also done to ensure proper traceability so that a robust and a continuous monitoring system could be established.

2.0 National Milk Quality Survey (NMQS)-2018

Scope, coverage & period

To assess the quality & safety of milk across the country taking into consideration the possible impact of seasonal/demand supply situation on the quality of milk, identify the hot spots of safety & quality concern, and to establish a robust continuous monitoring frame work for safety assessment of milk.

The survey panned 29 states and 7 union territories covering almost all major towns with population of >50,000 and a sample size of 6432 analysed qualitatively for 2 quality parameters (fat & SNF), 13 adulterants (vegetable oil/fat, detergents/caustic soda, hydrogen peroxide, sugar, glucose, urea, starch, Maltodextrin, boric acid, ammonium sulphate, nitrates, cellulose, and neutralizer) & 3 contaminants (pesticides, aflatoxin M₁ & antibiotic residues). Nearly 30% of the samples that failed for safety parameters were analysed quantitatively in the laboratory. The survey was conducted over a period of about Six months from 7 May to 31 Oct 2018.

Test parameters

Milk has been tested for 2 quality parameters, fat and SNF. Another parameter, namely protein was also tested even though there are no standards for protein in milk in India. Added water was also checked to verify the impact on fat and SNF.

It was tested for 13 adulterants, namely - 1) Vegetable Oil/Fat, 2) Detergents/ Caustic Soda, 3) Hydrogen peroxide, 4) Sugar, 5) Glucose, 6) Urea, 7) Starch, 8) Maltodextrin, 9) Boric acid, 10) Ammonium Sulphate, 11) Nitrates, 12) Cellulose, and 13) Neutralizers. There are no quantitative parameters for adulterants except urea, where limit of 700mg/kg has been set, and no limit for Ammonium Sulphate.

The following contaminants were also tested.

- Antibiotics 93 residues with MRL,
- Pesticides 18 residues with MRL,
- Aflatoxin M₁ with MRL of 0.5µg/kg

Sampling and methodology

The samples (6432) were collected from all major towns with population of >50,000 (as per census of India, 2011) covering 29 states and 7 union territories and qualitatively screened on the spot for 13 common adulterants (Vegetable Oil/Fat, Detergents/Caustic Soda, Hydrogen peroxide, Sugar, Glucose, Urea, Starch, Maltodextrin, Boric acid, Ammonium Sulphate, Nitrates, Cellulose, and Neutralizer) & 3 contaminants (pesticides, aflatoxin M1 and antibiotics). The samples that failed for safety parameters were analysed in the laboratory quantitatively.

Sample collection

State of the art real time data platform was employed for capturing the data online with user access and password for traceability of sampler/geographical location. Samples were collected from both organized and unorganized sectors by trained samplers using harmonized protocols and by entering the below details of the sample. The following information was captured in the software during sample collection.

- Date and time of sampling
- GPS location, Town name District State along with photograph
- Point of collection (Local dairy farm, Milk vendor, Local retail shops, Milk mandis, processing units)
- Name of the person/dairy form/ processing unit and contact numbers wherever possible,
- Type of milk (Raw buffalo milk, Cow milk, mixed milk, processed milk)
- Brand name, batch no. and expiry in case of retail packs/processed milk
- Temperature at the time of collection
- Sampling person details

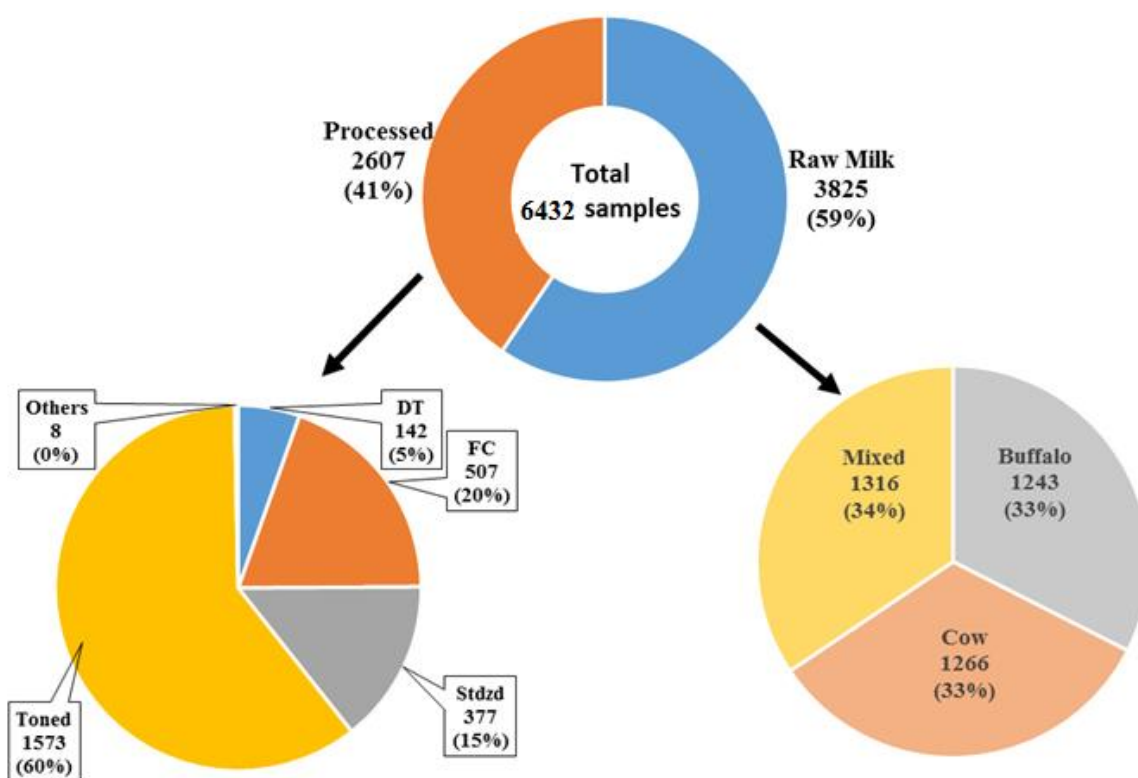
For the purpose of the survey, the following entities were considered under the unorganized sector - Local dairy farm (a farmer who has minimum of 10 cattle (Cows/buffalos) and supply to milkmandi/vendor/processing centres); Milk mandi (a place where farmers gather to sell to public or place where milk gets collected and further supplied to processing centres); and, Milk vendor (any person who has established shop and sells raw milk without processing).

Similarly, following entities were considered under the organized sector - Milk retailers/local dairy shops (shop which has established address to sell processed/ pasteurized milk); and, milk

processing centre (any unit which processes milk in large scale and supplies pasteurized milk packets to retailers).

The following pictogram presents the bifurcation of samples with respect to raw milk (buffalo, cow and mixed milk), various processed milk types.

Figure 1: No. of samples with respect to various types of milk



(DT: Double Toned; Stdzd: Standardized; FC: Full Cream)

Sample analysis

Milk samples were tested on-the-spot for qualitative parameters (protein, fat, SNF, excess water & 13 adulterants) by trained analysts in mobile food testing laboratories using ‘Milk-O-Screen’ instrument. The samples were also instantaneously screened for aflatoxin M₁, pesticides and antibiotics using validated rapid test kits. The 13 common adulterants included vegetable oil/fat, detergents/caustic soda, hydrogen peroxide, sugar, glucose, urea, starch, maltodextrin, boric acid, ammonium sulphate, nitrates, cellulose, and neutralizer.

Further, samples that tested positive for any of the adulterants and/or contaminants were shipped to the laboratory under chilled condition and tested quantitatively to ascertain whether the sample is compliant or non-compliant to the limits set. Adulterant quantitative analysis was done using

available methods from FSSAI manual for milk products; while, antibiotics & aflatoxin M1 by validated LC-MS/MS method and pesticides by validated LC-MS/MS & GC-MS/MS methods. Equipment accuracy and analysis uncertainty was considered in concluding the quantitative results for non-compliance.

3.0 Key findings of milk survey 2018

The results of the study were grouped into two major categories i.e., compliant (C) & non-compliant (NC) to the FSSAI standards. Further, the non-compliant samples were grouped into two categories as those samples that were non-compliant as sub-standard without any safety issues (those samples that failed in terms of quality parameters - fat, SNF, sugar, maltodextrin) and sub-standard with safety issues (those samples that failed in terms of parameters that lead to safety issues). The results of NMQS 2018 are summarized in Table 1.

Table 1 : Summary of Results

Criteria	Sample, Numbers	Sector wise				Overall, %
		Processed		Raw		
		Sample, numbers	%	Sample, numbers	%	
Total numbers sampled	6432	2607	41.0	3825	59.0	--
(a) Compliant	3289	1388	53.2	1905	49.7	51.1
(b) Non-Compliant (NC)	3143	1219	46.8	1924	50.3	48.9
(i) NC without safety issues	2505*	769	29.5	1736	45.4	39.0
(ii) NC with safety issues	638#	450	17.3	188	4.9	9.9
Total samples without safety issues	5794	2157	82.7	3637	95.1	90.1
Total unsafe samples	638	450	17.3	188	4.9	9.9

* : excludes the 279 samples that were substandard but failed for safety parameters

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The samples that were non-compliant as sub-standard without any safety issues (those samples that failed in terms of quality parameters - fat, SNF, sugar, maltodextrin) are summarized in Table 2.

Table 2: Non-compliant (NC) Samples due to Quality Concerns (No Safety Issues)

Test group / Parameter	Samples, numbers	Processed, No. of samples	Processed, %	Raw, No. of samples	Raw, %	Overall, %
Total NC	2505	769	29.5	1736	45.4	39.0
(a) NC for fat	1261	348	13.3	913	23.9	19.6
(b) NC for SNF	2165	729	28.0	1436	37.5	33.7
(c) NC for other parameters	218	187	7.2	31	0.8	3.4
Maltodextrin	156	148	5.7	8	0.2	2.4
Sugar	78	55	2.1	23	0.6	1.2
Cellulose	Nil	Nil	Nil	Nil	Nil	Nil
Glucose	Nil	Nil	Nil	Nil	Nil	Nil
Starch	Nil	Nil	Nil	Nil	Nil	Nil
Vegetable oil	Nil	Nil	Nil	Nil	Nil	Nil

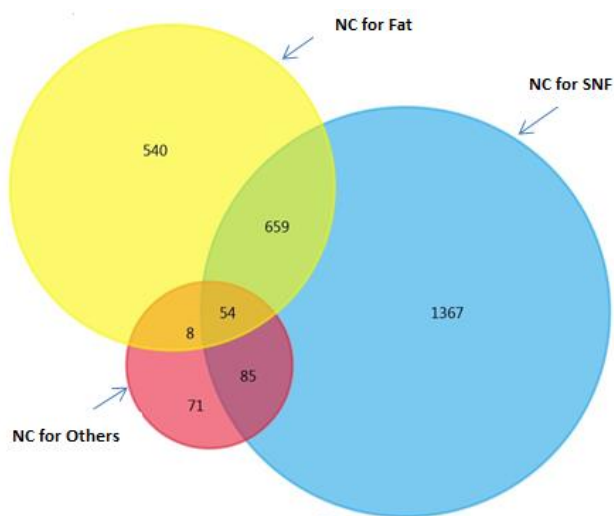
Note: The sum of individual failures will not match to total failures as some samples failed for more parameters

The following Venn diagram (Figure 2) provides pictorial view of samples failing for groups of parameters.

Figure 2: Venn diagram for Non-compliant, but safe (substandard)

From a total of 2505 NC (substandard) samples

- 540, 1367 and 71 did not comply with the set limits for fat, SNF and others (sugar or maltodextrin) respectively.
- 713 samples did not comply for fat & SNF contents; 62 samples did not comply for fat & others (Sugar or maltodextrin); 139 samples did not comply for SNF & others (Sugar or maltodextrin).
- 54 samples did not comply for fat, SNF & others (Sugar or maltodextrin).



The non-compliant samples with safety issues (those samples that failed in terms of parameters that lead to safety issues) are summarised in Table 3

Table 3 : Non-compliant (NC) Samples with Safety Issues

Test group / Parameter	Samples, numbers	Processed, No. of samples	Processed, %	Raw, No. of samples	Raw, %	Overall, %
Total NC with safety issue	638	450	17.3	188	4.9	9.9
(a) NC for Aflatoxin M1	368	227	8.6	141	3.7	5.7
(b) NC for antibiotics	77	42	1.7	35	0.8	1.2
(c) NC for pesticides	01	Nil	Nil	1	<0.1	<0.1
(d) NC for other Adulterants	207	195	7.4	12	0.3	3.2
Ammonium sulphate	195	190	7.2	5	0.2	3.0
Urea	02	Nil	Nil	2	<0.1	<0.1
Detergents	03	1	<0.1	2	<0.1	<0.1
Hydrogen peroxide	06	3	0.1	3	0.1	0.1
Neutralizers	01	Nil	Nil	Nil	<0.1	<0.1
Boric acid	Nil	Nil	Nil	Nil	Nil	Nil
Nitrates	Nil	Nil	Nil	Nil	Nil	Nil

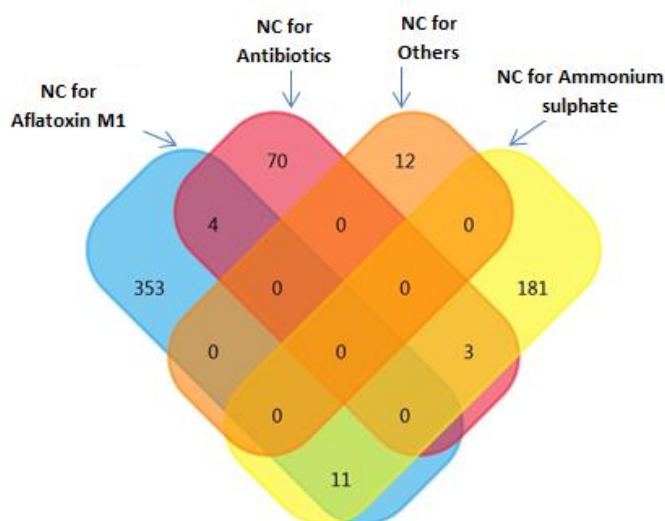
Note: The sum of individual failures will not match to total failures as some samples failed for more parameters.

The following pictorial representation (Figure 3) provides the overview of samples failing for multiple safety parameters.

Figure 3: Venn diagram for Non-compliant, and unsafe

From a total of 638 NC (unsafe) samples –

- 353, 70, 181 and 12 samples did not comply with limits for aflatoxin M₁, antibiotics, ammonium sulphate and other contaminants.
- 4 samples did not comply for Aflatoxin M₁ & antibiotics; 3 samples did not comply for antibiotics & ammonium sulphate; 11 samples did not comply for aflatoxin M₁ & ammonium sulphate
- No samples failed for all unsafe parameters.



Note: Non-compliant (Others) include Detergents, Hydrogen peroxide, Urea, Neutralizers and pesticides.

4.0 SUMMARY AND CONCLUSIONS

NON-COMPLIANT SAMPLES “WITH SAFETY ISSUES”

Having adulterants that render milk unsafe for consumption

1. The survey shows that merely 12 (out of a total of 6,432) samples had adulterants that affect the safety of milk. While, no samples failed for boric acid and nitrates, for neutralizers, detergents urea and hydrogen peroxide, number of samples that failed were 1, 3, 2, and 6 respectively. In all cases, this is less than 0.1% of all samples. This clearly shows insignificant levels of adulteration of milk in India. Hence from this large scale survey, it would be right to draw a conclusion that milk in India is largely free from adulterants that render it unsafe for consumption.

Having contaminants that make milk unsafe for consumption

1. For the first time, this survey analysed major contaminants including residues of pesticides, antibiotics, Aflatoxin. In addition, ammonium sulphate was also analysed. The survey shows that 638 samples (out of a total of 6,432 samples) had contaminants that make milk unsafe for consumption. This is less than 10 per cent of the overall sample size. In all these cases, milk is getting contaminated due to poor quality of feed, irresponsible use of antibiotics and poor farm practices. Quantitative analysis of contaminants suggests that even the issue of contaminants is not very serious. It is also restricted to few pockets and in some States. Hence, the country would be able to address this concern by targeted awareness building activities and monitoring of primary production over a period of time.
2. The milk was tested for residues of 18 pesticides in this survey. It is noted that only in one case, the pesticide level exceeded the minimum residue level (MRLs) permitted by FSSAI. This clearly shows that there is no concern about residues of pesticides in milk in India. We may however continue to monitor residue levels of pesticides in milk on an on-going basis to build public confidence in quality of milk.
3. The milk was tested for residues of 93 antibiotics and veterinary drugs in this survey. It is noted that residues of antibiotics were found in 77 samples (i.e. 1.2% of the samples). Oxy-tetracycline was the main antibiotic detected. Tetracycline is the major antibiotic group used to treat animals with bovine mastitis. Its occurrence may largely be due to ignorance of the

farmers about withdrawal periods necessary for eliminating their secretion into milk. Sometimes, extra dosages are administered to cattle or the feed is contaminated. There could also be cases of use of unlicensed antibiotics. It is also believed that some primary producers use sub-therapeutic doses of antibiotics to prevent diseases. Such practices inadvertently expose healthy cattle to antibiotics. There is a need for awareness building activities and effective guidance in animal husbandry practices; and a residue prevention strategy by having a proper drug use guide, proper maintenance of treatment and health records, and identification of treated animals and such milk is not sold while the animal is under treatment. The survey also shows that this problem is restricted to a few pockets and in some States, therefore we would be able to address this concern by targeted awareness building activities and monitoring use of antibiotics and veterinary drugs over a period of time.

4. The milk was tested for Aflatoxin M₁ in this survey with a tolerance limit of 0.5 µg/kg. Aflatoxin M₁ was detected in 368 (out of 6,432 samples), that is 5.7% of the samples at levels above the permissible limit. Further, analysis showed that 3 per cent samples had Aflatoxin levels within 2 times the MRL (i.e., <1.0 µg/kg) while 1.4% had levels ranging from 2 to 5 times the MRL and the remaining 1.3% had Aflatoxin over 5 times the MRL. Aflatoxin M₁ is the principal hydroxylated aflatoxin metabolite present in the milk of dairy cattle fed a diet contaminated with aflatoxin B₁, and literature suggests that the metabolite is also present in the milk of human nursing mothers consuming foodstuffs containing aflatoxin B₁. Aflatoxin M₁ is a metabolite of aflatoxin B₁ that is produced during normal biological processes of animals. Aflatoxins are produced by *Aspergillus flavus* and *Aspergillus parasiticus* which can contaminate feed. Aflatoxin is found in maize and cottonseeds and in their by-products. Favourable conditions of temperature, relative humidity/moisture, poor storage conditions, substrate composition, and storage time play an important role in fungal growth and contribute to the synthesis of these toxins. Most effective way of controlling Aflatoxin M₁ is by reducing contamination of feedstuff by Aflatoxin B₁ for dairy cattle. It must be noted that occurrence of Aflatoxin does not amount to wilful adulteration, but is directly related to feed quality and has bearing on public health. The survey shows that this problem is restricted to a few pockets and in some States, therefore we would be able to address this concern by having targeted awareness building activities for farmers and their adoption of good storage and transportation of feed.
5. The milk was tested for Ammonium sulphate in this survey. Ammonium sulphate was detected in 195 (out of 6,432 samples), that is 3 % samples of milk. Currently, the FSSAI

regulations do not prescribe any limits for ammonium sulphate in milk. Quantitative analysis shows that level of Ammonium sulphate in milk ranged from 181-840 ppm. Out of the 3.0% of samples, quantitative analysis revealed that 1.7% of the detected samples found at <350 ppm, 1.2% at 350-700 ppm & 0.1% at >700 ppm. Presence of Ammonium sulphate could be due to the addition of ammonium compounds to animal feed and fodder/silage. FAO reports that feed is allowed to be enriched with Ammonium compounds and Ammonium sulphate and it is safe for cattle and sheep to add to the protein intake of animals. Further, study is required to verify natural levels of ammonia and sulphates in milk and fixing tolerance limits, if any of ammonium sulphate in milk.

NON-COMPLIANT SAMPLES WITH “QUALITY ISSUES”

1. Fat, solid non-fat (SNF) are usually considered to be satisfactory measures of overall quality of milk, but these vary widely by species and depend on breed as well quality of feed and fodder. Chilling plants and milk processors often use measure of fat and SNF to determine the cost of milk. Despite its limited purpose, FSSAI regulations have specified the minimum standards of fat and SNF for various types of milk. For Standard milk and Mixed milk, it is 4.5 for fat and 8.5 for SNF, for cow milk, it is 3.2 for fat and 8.3 for SNF, and for buffalo milk, it is 5.0 or 6.0 (depending on States) for fat and 9.0 for SNF. It is different for toned milk, double toned milk and full cream milk.
2. The milk was tested for levels of fat and SNF in this survey against standards of fat and SNF for various types of milk. It is noted that as many as 1261 (19.6%) of the samples did not meet standards of fat and 2165 (33.7%) of the samples did not meet standards of SNF. In another 218 samples (3.4%) of the total, Sugar and Maltodextrin was found to be added. Sugar and Maltodextrin is sometimes added to raise the level of fat and SNF. Overall 2505 samples (39% of the total) did not meet quality parameters.
3. Non-compliance on Fat and SNF quality parameters is higher in raw milk than in processed milk, but on added Sugar and Maltodextrin, non-compliance is mostly in processed milk. Unlike non-compliance on safety parameters, non-compliance on account of quality parameters is across all States / UTs, even though extent of such non-compliance varies.

4. While, a more detailed and nuanced analysis of non-compliance on quality parameters is needed. As far as raw milk is concerned, it must be stated that this could either be due to quality of cattle, its feed and rearing practices itself or due to dilution of milk with water. Addition of water in itself is not a safety issue unless there is concern about the quality of water added that calls for detailed microbiological examination to assess this risk. Since, in most cases, liquid milk is boiled and then consumed, public health risk due to microbiological contamination is minimal.
5. To get the right quality of milk, cattle should be properly fed with proper care and good management practices must be followed. Improving farm practices, storage and handling practices are required to be emphasized through various extension activities at village or dairy farm level. Conduct of awareness programs at dairy farms about nutritious feed may improve in increase of fat and SNF levels to desired limits specified by the FSSAI.
6. The milk was tested for added Sugar and Maltodextrin in this survey. A total of 234 samples (3.4% of the total samples) were found to be added with Sugar & Maltodextrin. A large majority of this addition was found in processed milk samples, perhaps added to increase SNF content of the milk. While, there may not be any public health issues, however addition of Sugar, Maltodextrin is to be discouraged completely.
7. Non-compliance on quality parameters in processed milk even though lower than raw milk is still significantly large. This issue needs to be address through various measures. High percentage of non-compliance samples however does not suggest that proportionate volume of processed milk is non-compliant, since samples are adjusted capacity of milk processing plants. It is most likely that a large number of samples are smaller plants.

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VIMTA Labs headquartered in Hyderabad has the largest pan India network of food testing laboratories (10 locations in Pune, Ahmedabad, Kolkata, Indore, Bengaluru, Bhimavaram, Nellore, Visakhapatnam, Kochi and Kolkata) to serve the Food Industry requirements for reliable, fast and quality testing services. All the food testing laboratories are ISO/IEC 17025:2005 accredited by NABL and notified by FSSAI. Other accreditations of VIMTA Labs include BIS, EIC, APEDA, AGMARK, Tea board, European commission. The residue (contaminants) testing labs at VIMTA Labs are compliant to GLP and approved by National GLP monitoring authority, NGCMA.

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