Synthetic milk – Genesis, current status and options

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With annual milk production approaching nearly 70 million tons, India is poised to become the world's top milk producer. However, the phenomenon of synthetic milk has cast a shadow on this unique achievement. What is 'synthetic milk?'. It is a product closely resembling milk, but having none of the nutrients found in natural milk. It differs from adulterated milk in the sense that in adulterated milk, the bulk of the mixture is natural milk to which additional components, e.g. fat, neutralizers, sugar, salt, formalin, hydrogen peroxide, etc. are added to improve saleability or keeping quality, while in synthetic milk the bulk of the mixture does not contain natural milk at all.

Synthesis and composition

Synthetic milk is prepared by mixing appropriate amounts of vegetable oil, urea, detergent caustic soda, powdered sugar/salt and skim milk powder to water, followed by thorough blending in a mixer. The liquid formed has the appearance of thick, rich, creamy milk and visually is identical to natural milk. Table 1 gives a comparison of the properties of synthetic and natural milk. From the comparison it is clear that synthetic milk can be detected easily. This indicates that it is not meant to be sold as such, but to adulterate natural milk on a large scale. At levels below 10%, synthetic milk adulteration in natural milk becomes extremely difficult to detect[1].

Detection

Synthetic milk is not a well-defined product for which a single test can be developed. Most of its ingredients, viz. refined oil, caustic soda, sugar, urea and common salt are the same as used in adulteration of milk. The only component that appears to be exclusive to synthetic milk is *detergent*. Detergent is an altogether 'foreign' component in milk, for which no test is presently available.

Urea, on the other hand, is a natural component whose concentration varies from 20 to 70 mg/100 ml milk. However, this concentration is quite low compared to that in synthetic milk in which the concentration is nearly twenty times. Consequently, detection is easy by a simple and rapid platform test, the DMAB (*para*-dimethyl amino benzaldehyde) test[2]. The test can be used to detect synthetic milk adulteration in natural milk at a level of 10% or more. Boiling the sample does not affect results[1].

Simple platform tests for detection of caustic soda and other neutralizers are already available[3] as are tests for added sugar[4]. For detection of vegetable oils and animal fats, no simple platform tests are available, as the available tests e.g. butyrorefractometer reading (BR test), opacity and crystallization test, gas liquid chromatography (GLC) profile, are laboratory-based tests requiring instrumentation, trained personnel and adequate facilities.

Genesis

Factors which have contributed to the genesis of synthetic milk are: a) Unorganized milk production, b) Ready market for milk, c) Laxity in quality control, d) Lopsided demand-and-supply position, e) Manpower limitation of law enforcement agencies and, f) Connivance of the dairy industry itself.

Out of the total production, only about 10% comes from organized sector, leaving open a huge amount of milk vulnerable to adulteration. Fat and solid-not-fat (SNF) content being the indicators of milk quality *vis-à-vis* its price, techniques for raising fat in milk have always been in the forefront, making adulteration highly profitable. Also, dairy delicensing under the government's new economic policy led to mushrooming of dairy plants, whose capacity far exceeded milk surplus generated by a particular milkshed. In Punjab alone, plants with a processing capacity of more than 55 lakh litres per day have become operational, though the marketable surplus is only around 30 lakh litres. Similarly, in Haryana, private plants with a capacity of 24 lakh litres per day

Table 1. Comparison of the properties of synthetic milk and natural milk

Properties	Synthetic milk	Natural milk
Physical		
Colour/appearance	White, identical to that of natural milk	White
Odour	When freshly prepared, the mixture has a 'soapy' smell, which disappears on overnight storage at 4°C	Not distinctive
Taste	Extremely bitter. The mixture is not palatable at all	Palatable
Density	1.025–1.035	1.025–1.035
Storage	At room temperature shows spoilage and appearance of yellow colour	Curdling but no change in colour
Texture	When rubbed between fingers, gives a soapy feel	No soapiness or distinctive texture
Boiling	On boiling, becomes yellow. Soapy odour	No yellowing. No distinct odour
Chemical		
Fat	4.5%. Can be varied easily	4.5% for standardized milk
pH	Highly alkaline, 10.5	Slightly acidic. 6.4–6.8
Urea test	Highly positive. Intense yellow colour	Weakly positive. Faint yellow colour
Urea concentration	14 mg/ml	0.2–0.7 mg/ml
Sugar test (Resorcinol)	Positive	Negative
Neutralizers test (Rosolic acid)	Positive	Negative

have been installed, though the milk surplus is only around 4 lakh litres. This creates tremendous pressure on available market supplies, providing an incentive to adulterators. The manpower limitation of law-enforcement agencies and consumer laxity only encourages such malpractices. Lastly, connivance of the dairy industry too is one of the factors. The attitude that as long as dairy plant capacity is utilized, quality considerations can be relegated to the background, has led to production of sub-standard and spurious raw material, i.e. milk.

Current status and implications

The phenomenon of synthetic milk is quite recent, with first reports about it appearing from Kurukshetra, Haryana[5]. However, if recent media reports are any indication, it has already spread to other parts of Haryana and also to the neighbouring states of Himachal Pradesh, Punjab, Rajasthan and Uttar Pradesh.

Prominent organizations, viz. Indian Council for Enviro-Legal Action, Environment Protection Council, Haryana and the Indian Dairy Association have expressed concern and urged the government to take strict action against manufacturers of synthetic milk. Protest at individual consumer level has, however, been meagre.

Development of simple, chemical tests for detection and adoption of common, standardized protocols can go a long way in monitoring milk quality. In this context, a meeting was organized by the Union Health Ministry at the National Dairy Research Institute (NDRI), Karnal, in July 1996. It was attended by public analysts from the five worst-affected states, viz. Rajasthan, UP, Haryana, Punjab and Delhi, senior scientists of NDRI, Director, Central Food Laboratory, Calcutta and representatives of the DGH's Central Prevention of Food Adulteration unit. While a common protocol for the testing of urea, caustic soda, animal/vegetable fats was agreed upon, the adoption of a universal method for detection of detergents was left open. It was felt that since several detergents could be used to adulterate milk, an indepth study and survey has to be conducted before deciding on the method for testing of detergents.

The phenomenon has a serious bearing on the health and economy of the nation. The long-term ill-effects of synthetic milk on the health of an individual cannot be denied. Studies have indicated toxic effects of neutralizers in milk[6]. Moreover, economic considerations are also involved as export of dairy products is likely to be seriously hit if timely measures are not taken to check the menace.

Future strategies and options

From the preceding discussion, some factors emerge which can form the basis of a strategy to curb the spread of synthetic milk. These are: a) Closure of unregistered processing units, b) Limiting the opening of new ones, c) Encouraging collection of milk at grass-root level, d) R&D pertaining to quick and easy methods for detecting adulterants, e) Linkage between public analytical labs and research institutions, f) Need for re-evaluating existing prevention of food adulteration (PFA) standards, and g) Vigilance on part of the dairy industry.

Closing of unregistered units and limiting the opening of new ones would help in easing market pressure which makes adulteration lucrative.

Attempts at a co-operative pattern of milk collection need to be encouraged. A strong grassroot system of collection where suppliers are small and marginal farmers, makes large-scale adulteration very difficult besides bringing a large segment of producers into the organized sector. The success of co-operatives is evident from the fact that virtually all of New Zealand's milk is procured and processed by co-operatives.

R&D pertaining to quick and easy methods of detection, needs to be taken up on a priority basis. The need is for developing kits for rapid detection of adulterants in milk. This requires a sustained research effort and rigid field trials. Since the chemical nature of both milk and potential adulterants is well-known, this should not pose to be too difficult a task. Moreover, availability of simple kits can help in checking adulteration at individual consumer level too. In this regard, a simple kit for detection of some of the common adulterants in milk, viz. urea, starch, glucose, sugar, hydrogen peroxide, pond water and neutralizers has been developed by NDRI[7]. However, it has not been commercialized yet. A word of caution! The kit is not the final solution. If components other than the ones being detected are used in formulation of synthetic milk/adulteration, e.g. some other salts or substances instead of sugar, urea, etc. the tests would be negative and the kit will fail. In view of the ingenuity shown by adulterators of milk, continuous research efforts must be undertaken for developing new kits and rapid platform tests.

The state level laboratories need to be well-equipped for the task of analysis of synthetic milk samples by latest methods. It is not enough for scientists to develop methods and report them in journals, with the expectation that they would be adopted by state analysts. There is need for regular training programmes for state analysts and voluntary agencies by premier bodies such as NDRI and the NDDB, for quick transfer of improved methods of detection.

Evaluation of PFA standards according to changing trends is necessary, because in our country major production is in unorganized sector and uniform feeding practices are not feasible. Milking practices, feeding pattern, environment, etc. are all factors which influence the composition of milk.

Lastly, vigilance on part of the dairy industry itself can go a long way in checking the quality of milk and is more likely to succeed where laws and legislation have failed.

Conclusion

Synthetic milk is our own creation and it is up to us to deal with it. It is we – the scientists, technologists and managers who must join hands to find a solution to this problem. We owe this much – to the common man and to our children.

1. Bansal, P., unpublished observations.
2. Singhal, O. P., Bector, B. S. and Ram, M., *NDRI Annual Report 1993–1994*, pp. 81–82.
3. Arora, K. L. and Balachandran, R., *Indian Dairyman*, 1995, **47**, 47.
4. *ISI Handbook of Food Analysis*, Part XI (Dairy Products), Manak Bhawan, New Delhi, pp. 17.
5. *Indian Express (Chandigarh)*, 29 November 1994.
6. Arora, N. and Kansal, V. K., *J. Food Sci. Technol.*, 1986, **23**, 213–216.
7. Raj, D., Seth, R. and Singh, A., *NDRI News*, 1997, **2**, 1.

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