



Milk adulteration and media coverage regarding milk and milk products: A review

Dr Renuka Malik*

*Associate Professor, Home Science, GC Bahadurgarh, Haryana, India.

Abstract:

Milk in its natural form is a very high value food and is an essential commodity in life. It is good source of protein as well as calcium and riboflavin besides other nutrients. The gap between production, consumption and inability of regulatory network to check the adulteration for making easy money via milk adulteration at the cost of health and nutrition of consumers Milk adulteration is a social problem exists in most of developing as well as some developed countries. Paper presents a comprehensive review on main milk adulterations, studies done this subject in various cities and media coverage about health hazards related to the adulteration. This study intends to contribute towards the common knowledge base regarding consumer awareness about the subject.

Keywords: adulteration, milk and milk products consumer awareness

Introduction:

All the food producers, regulators, retailers and consumers have interest in safeguarding food and ensuring they are safe, genuine and of the highest quality. Food adulteration have been reported since Roman times. During those times, the food adulteration was limited to smaller geographical region and to a few articles like dilution of wine with water or with colouring agents (Armstrong 2009; Spink and Moyer 2011). According to FDA (2009), adulteration can be economically motivated and can be defined as "the fraudulent, intentional, substitution or addition of a substance in a product for the purpose of increasing the apparent value of the product or reducing the cost of its production". Adulteration in milk is considered to reduce its quality and increase the quantity. Adulterant is a substance found within other substances which is not allowed for legal or other reasons. The addition of adulterants is called adulteration. Although the motivation for adulteration is financial, the impact is a real threat to public health (Spink and Mayor 2011). The United States Pharmacopeia (USP) analyzed 25

food ingredients which were most prone to adulteration worldwide. After olive oil, milk was found to be the most adulterated food product (Moore et al. 2012). The main objective

of this paper is to analyse adulteration in milk and milk products in National Capital Region (NCR) at the same time its media coverage given for public awareness.

Media coverage about milk adulteration

The media coverage has played an important role today's society. It is one of the most powerful instruments of communication as it helps in providing information regarding milk adulteration and creating awareness among consumers from time to time (Table 1).

Table 1: Media coverage of milk adulteration by different agencies

Media	Date	Headlines	Reported
BBC News			
	January 22, 2009	Chinese milk scam duo face death.	-Two persons were given death penalty who were responsible for milk adulteration with melamine, which led to death of 6 babies and made 3, 00,000 ill.
	April 22, 2004	China 'fake milk' scandal deepens.	-45 types of substandard milk powder were sold in Fuyang city, Anhui, produced by 141 factories -at least 13 babies died.
	April 20, 2004	China babies die 'from fake milk'.	- Over 200 Chinese babies were reported died from malnutrition after being fed fake or inferior quality baby milk powders. - The babies developed "big head disease", where infant's heads appear abnormally large in comparison to their bodies.
	January 02, 2004	Baby bug threat from formula milk.	- Presence of bug ' <i>E. sakazakii</i> ' in samples from contamination of formula milk can cause serious illness in newborns. -Samples were collected in 1993.
Zee News			

	May 30, 2015	Supreme Court asked state governments to curb sale of adulterated milk.	-The Supreme Court of India expressed concern over the incidences of sale of adulterated milk as a 'serious issue' in the country and directed state governments to take strict action against it.
	May 30, 2015	Milk vendor got 6 months jail for adulteration	-Local court awarded milk vendor 6 months imprisonment under Prevention of Food Adulteration Act (PFA).
	May 27, 2015	Food and Drug Administration	-In total, 40 samples collected from 19 dairies, 3 from Mumbai, 4 from Thane and

		launches drive to check milk adulteration.	rest from Pune. The FDA team also confiscated 936 liters of milk from Mumbai worth Rs 37,835. - Dept. filed FIR against two milk vendors
	December 15, 2014	Laws to prevent adulteration of food and milk to be made more stringent.	-The Health Minister J P Nadda informed Lok Sabha that looking at the cases around India, it is 'slow poison' in the form of milk that create 'serious health hazard'. The Minister recommended that laws to prevent food and milk adulteration to be made more stringent and task force should be set up to revisit current legislation.
	November 11, 2014	Milk adulteration: Supreme Court asks center to consider amending law.	-The Supreme Court termed the issue of adulteration in milk and milk products as 'very serious' and recommended that it should be made offence punishable with life imprisonment.
	December 5, 2013	Make milk adulteration punishable with life imprisonment: SC.	-The Supreme Court of India urged state governments to make necessary amendments to their laws to make production and marketing of adulterated milk as an offence punishable with life imprisonment.
	August 2, 2013	Give kits to dairies to detect milk adulteration: High Court to government.	-The Bombay High Court took a serious note of sale of 'synthetic milk' and directed state government to provide every dairy a testing kit to detect the presence of chemicals.



	October 28, 2012	High Court quashes conviction of 19 year old milk adulteration case.	-High Court quashed the conviction of a dealer booked in milk adulteration case after 19 years of offense on the basis of 'sharp and substantive variation' in two different reports on tests of purity of the dairy products.
	May 9, 2012	Supreme Court issued notice to center and states over milk adulteration.	-The apex court notice was sent to U.P., Haryana, Delhi, Punjab and Uttrakhand government besides center on the purity of milk.
	January 25, 2012	Milk adulteration: High Court issues notices to Maharashtra government and center.	-High Court issued notice to agencies engaged in milk distribution in Maharashtra seeking action against large scale adulteration of milk.
	January 25, 2012	Milk in Delhi clean: Delhi government to High Court.	-Delhi government gave clean chit to all leading milk suppliers saying that no sample of milk was found having material injurious to health.

	January 11, 2012	Delhi High Court notice to government on milk adulteration.	-In response to connection with PIL seeking action against large scale adulteration of milk, the High Court took suo motu notice of media reports that around 70 percent milk supplied is adulterated and issued notices to Delhi government and central government.
	January 11, 2012	Food sample found adulterated after milk.	-News that shocked whole country was revelation by FSSAI that 13% of food stuff is contaminated across the country.
	January 10, 2012	Health Ministry, Delhi Milk Scheme to meet over milk adulteration.	-Over 70% milk supplied across country is adulterated as reported by FSSAI. Health Ministry called urgent meeting with DMS and milk producer Mother Dairy.
Time of India			

March 16, 2016	Noida: Food department launches antiadulteration drive ahead of Holi.	- District food safety department launched enforcement drive to check selling of adulterated food items and milk products in markets ahead of national festival holi.
March 14, 2016	Food adulteration awareness program held, website to be launched soon.	-A local club conducted an awareness program on food adulteration and its ill effects and how public participation would prevent it.
December 30, 2015	Gutter fate for adulterated milk and ghee.	-FSDA, district officials along with police raided godown and thrown 5000 liters of pungent smelling sour milk and 234 kilograms of ghee into gutter in Etah district of U.P. state.
August 24, 2015	Milk adulteration rackets busted.	-FSDA, caught red handed people involved in adulterating milk in Mumbai city.
March 18, 2016	Milk adulteration: 2 years on, law still in cold storage.	-Due to bureaucratic hurdles and lack of interest, legislation to punish errant milk suppliers is still pending.
March 17, 2016	68% of milk adulterated, new kit to test in 40seconds.	-With 68% of the milk in India found adulterated in 2011 by FSSI study, the government is working towards providing an accurate, portable kit to detect adulteration in

		milk in 40 seconds.
June 30, 2016	Gang involved in adulteration of milk busted on National Highway, 4 held.	-Bhilwara police arrested milk adulteration gang on National Highway 73. Mixing hazardous chemicals in the containers to retain its volume and fat, for consumption in Jaipur.

	July 16, 2015	‘Stricter laws against adulteration of milk’.	-Nearly 1000 liters of adulterated milk was seized from Mumbai. Raids at railway stations in Mumbai and Solapur found bottles of inferior quality milk samples adulterated with starch.
The Indian Express			
	August 05, 2015	White poison: why drinking milk could prove fatal for you.	-Paper analyzed that consumption of adulterated milk can cause serious health issues like heart problem, cancer and even death.
First Post			
	August 12, 2015	Madhya Pradesh dairy owners caught adulterating milk with bleaching agent.	Milk was adulterated with ammonia fertilizers, starch, cereal flours, glucose, sugar, salt, maltodextrin, detergent, nitrate fertilizers, hydrogen peroxide, unhygienic pond water, neutralizers, vegetable oil and urea.
DNA (E-paper)			
	May 28, 2015	Maharashtra FDA bust milk adulteration racket.	Up to 935 liters of milk seized in the Mumbai city from two milk adulteration dens.
The Hindu			
	January 24, 2013	Urea, formalin, detergent. Your cup of milk could contain all this.	A cocktails prepared of chemicals like urea, detergents, formalin, starch, sugar, salt and other agents (hydrogen peroxide, bone dust, animal fats and harmful preservatives).

As from above discussion, milk adulteration is either due to poor hygienic conditions of processing, storage, transportation and marketing or for financial gains. The adulteration has been widely reported in many developing countries which are highly populated such as

Pakistan, Brazil, India and China (Xiu and Klein 2010; Faraz et al. 2013; Shaikh et al. 2013; Mu et al. 2014; Singulri and Sukumaran 2014).

The adulterants/preservatives can have negative hazardous effect to the health of end consumers, particularly infants (Table 2.8). Milk suppliers found three ways to increase their profit margin from the sale of milk that is either dilution or extraction, or a combination of both dilution and extraction of valuable components. Milk fat is removed as cream or milk is added with cheap (sometimes potentially harmful) bulking additives, such as low quality flour, to bring the total solid to a level which is acceptable to consumers. Some of the chemicals, adulterants and malpractices results in public health concern and malnutrition.

Table 2.8: Common adulterants in milk

	Common Adulterants in milk	Cause	Diseases caused
1	Water	-Increase profits by diluting with water to increase the volume of milk.	This not only reduces its nutritional value, but contaminated water can also cause additional health problems.
2	Urea	-Increase profits by blending with other ingredients to produce synthetic milk. -Urea artificially increases the protein content.	Vomiting, nausea and gastritis.
3	Starch	-Increases profit by giving false thickness and fat in milk.	Solid milk paste can cause stomach diseases
4	Detergent	-Increased profits by adding to diluted milk to enhance cosmetic nature. -Accidental contamination through low maintenance of milk tanks.	The detergent contains sodium that can act as slow poison for those suffering from hypertension and heart ailments.
5	Caustic Soda	-Used to avoid curdling and increasing shelf life of milk.	Dangerous for people suffering from hypertension and heart ailments. Harms the mucosa of the food pipe, especially in kids
6	Cane Sugar	-Used to increase the solid contents of milk.	Decreases the nutritious value of the milk

7 Formalin/ -Increased profits by adding to Causes more severe damage to

.		Melamine milk to artificially increase the the body like liver damage protein content.	
8	Oil - Replacement of milk fat with vegetable oil for economic gains. but at the same time is very bad for consumption	Gives creamy texture to the milk	
9	Other synthetic compounds and acidity values of preserved milk to pass it off as problems, cancer, and nates)	-Reducing costs by masking the pH The other synthetic compounds badly impair the functioning of various Neutralizers(carbonates/bicarbonates) sometimes death.	

The main driving force for this practice is to increase the profit through gains in volume and extended shelf life. However, adulteration of milk can be potentially harmful to human health and the economy (Souza, 2011; Mendes et al. 2016). One of the oldest and simplest form of milk adulteration is through the addition of water to artificially increase its volume. In addition to water, whey, stabilizing agent, preservatives such as hydrogen peroxide (H₂O₂) and acidity regulator, such as sodium hydroxide (NaOH) , nitric acid and urea are also added to milk (Kandpalet al. 2012; Mendes, 2016).

Table2.9: Studies on adulterants detected in milk in various cities of India and neighbouring countries

S.N.	Names of researcher/s	Year	City	Adulterants detected in milk
1.	Makadiya and Pandey	2015	Gujarat	-Urea (100%), ammonium sulfates (96%), sucrose (50%), sodium chloride (46%), glucose (30%).
2.	Isalkar, Umesh	2015	Pune	Sugar, glucose, edible oil, milk powder (local vendors, dairies).
3.	Singuluri and Sukumaran	2014	Hyderabad (Andhra Pradesh)	- Sucrose (22%) and the highest for skim milk power (80%). - Neutralizers (26%), sodium chloride (82%), and urea (60%). -Detergents 44% samples, formalin and hydrogen peroxide 32%.

4.	Barham et al.	2014	Sind, Pakistan	- Water 73%, detergents (32%), cane sugar (22%), caustic soda (20%), rice flour (17%), skimmed milk power (15%), hydrogen peroxide (13%), starch (12%), formalin (11%), urea and vegetable oil (10%), boric acid (8%), ammonium sulfate (6%), glucose (5%), sorbitol (4%), and arrowroot (1%).
5.	Soomro et al.	2014	Pakistan	-Water content from milk producer (60%), milk collector (53.5%), milk vendor (62.7%) and dairy shops (56.2%).
6.	Centre for Science and Environment (CSE)	2013	India	Urea, starch, glucose, formalin along with detergent are used as adulterants.
7.	Jain and Mediratta	2013	Gwalior city (M.P.)	Ammonium sulphate, urea, formaldehyde, detergent, skimmed milk (Urban area), water (rural area).
8.	Shrishti Narwal et al.	2013	Dehradun (Uttarakhand)	Glucose 80% skimmed milk power 58% salt 50%, urea 35% (Dairy owner).
9.	Shaikh et al.	2013	Hyderabad (Pakistan)	-Water found in 100% samples.
10.	AltafMosvi et al.	2012	Kashmir Valley (J&K)	Starch, rich flour.
11.	Kandpalet al.	2012	Dehradun (Uttarakhand)	- 80% diluted with water. - Urea and detergents
12.	Sinha, Kounteya	2012	India	Fat, neutralizers, hydrogen peroxide, sugar, starch, glucose, urea, detergent, formalin and vegetable fat.
13.	Rani Rupa et al.	2012	Rambag region, Agra	Urea.

			(U.P.)	
14	Stancati, Margherita	2012	India	Detergents, hydrogen peroxide, urea.
15	Altaf M.S. et al.	2011	Srinagar (J&K)	Starch / rich flour.

16	Liu et al.	2010	China	- The mean exposure dose of melamine was approximately 116 mg per day. 43 (89.6%) of the 48 affected were children.
17.	Singh J.P. et al.	2008	Shikohabad (U.P.)	Water and did not meet the legal standard of milk quality (vendor milk, organized dairies and unorganized dairies).
18.	Sandeep Arya	2008	Summer season in Haryana	Urea, formaldehyde, carbonate (vendor milk)
19.	Singh J.P. et al.	2008	Shikohabad (U.P.)	Water and did not meet the legal standard of milk quality (vendor milk, organized dairies and unorganized dairies).
20.	Yadav R. et al.	2008	Kanpur city	Detergent power, urea, foreign fat, starch, formaldehyde and skimmed milk.
21.	Bhatt et al.	2008	Utter Pradesh	- Urea, detergents, vegetable oil.
22.	Deogade A.H. et al.	2007	Parbhani city	Substandard (low in fat, SNF content and high in acidity indicating adulteration).
23.	Saxena G. et al.	2004	Jaipur (Rajasthan)	Neutralizers, sugar formaldehyde salt (market milk and vendor milk)
24	Rao L.V et al.	2004	Hyderabad (Andhra Pradesh)	Could not meet the legal standards (private Dairies).
25.	Kolhe R.P. et al.	2003	Nagpur city (Maharashtra)	Sugar, starch, sodium bicarbonate and urea.



26.	Rao A. V. et al.	2002	Hyderabad (Andhra Pradesh)	Water, starch and neutralizers (local vendor milk).
27.	Beniwal and Khetarpaul N.	1999	Hissar (Haryana)	Water 70% cases (Household).
28.	Amrita Kadian et al.	1998	Haryana	Carbonates, sugar.



Milk adulteration and synthetic milk issues in India have been widely reported in the mass media and this has been supported by the reports from research scientists and government authorities (FSSAI 2011; Lipp and Morre 2013). The survey done by FSSAI (2012) has revealed real picture regarding milk adulteration in India. The problem was also shown to be much greater for milk sold in bulk than packaged milk. The national survey also exposed water as being the most common adulterant used in milk in India. Bhatt et al. (2008) surveyed a total of 365 households in Uttar Pradesh in India about the daily intake of milk in children and to determine their effect on health. Adulteration detection in milk samples with urea and detergent ranged from 8 percent in rural areas to as high as 40 percent in urban areas. The adulteration of milk further lead to health problems like eyesight, diarrhoea and headaches.

Singuluriet al. (2014) collected 50 samples of milk and studied in detail the hygienic status of milk supplied to various cafes, small hotels and other public and educational institutions from Hyderabad city of India. In their study, they found that sucrose and skim milk powder were present in 22 percent and 80 percent of the milk samples. Urea, neutralizers and salt were present in 60 percent, 26 percent and 82 percent of milk samples respectively. Formalin, detergents and hydrogen peroxide were present in 32, 44 and 32 percent of milk samples obtained.

Conclusion

One of the main reasons of milk adulteration is financial gains, inadequate supply for increasing population all over world has paved the ground for milk adulteration as well. Adulterated milk and milk products become dangerous to health of any living humans as milk is adulterated with inferior, chemicals and cheaper materials like pond water, milk power, cane sugar, urea, melamine, glucose and detergents. Hence, it is essential to generate awareness among consumers about the malpractices and negligence in milk and related sectors. More emphasises should be on making easy detection method at consumer level. The milk control measures should be strong enough to counter milk adulteration. There should calls for combined efforts from scientific communities and the regulatory authorities from top to bottom, through development, implementation and dissemination of good techniques for the detection of milk adulteration.

REFERENCES

1. Altaf Mosvi, Mehboob Willayet, Manzoor Ahmed, Asif Iqbal and Rayaz Chauhan (2012). A study on the bio-typing of *Bacillus cereus* emetic strains isolated from raw milk and milk products in Kashmir Valley. *Vet nary Scan*, 7(1), 106.
2. Altaf, M.S., Hussain, S.A., Ahmad, C.R., Willayet, M.M., Imtiyaz A.H., and Shakoor Bhat (2011). A study on the prevalence of *bacillus cereus* emetic strains in raw milk in and around Srinagar city of J&K. *Biochemical and Pharmacology Journal*, 4 (1), 181-188.
3. Amrita Kadian, Srivastava, D.N. and Dabur R.S. (1998). Evaluation of quality of milk powers manufactured in Haryana. *Indian Journal of Dairy Science*, 51 (5), 285-288.
4. Armstrong, D.J. (2009). Food chemistry and U.S. food regulations. *Journal of Agriculture and Food Chemistry*, 57:8180–8186.
5. Arya, Sandeep (2008). Bovine milk adulteration with synthetic milk during the summer season in Haryana, India. *Progressive Research*, 3(2), 139-142.
6. Barham, G.S., Khaskheli, M., Soomro, A.H. and Nizamani, Z.A. (2014). Extent of extraneous water and detection of various adulterants in market milk at Mirpurkhas, Pakistan. *Journal of Agriculture Vet nary Sciences*, 7(3), 83–89.
7. Beniwal, A. and Khetarpaul, N. (1999). Knowledge of consumers regarding the nature and extent of adulteration of India food. *Nutrition and Health*, 13 (3), 153-160.
8. Bhatt, S.R., Singh, A. and Bhatt, S.M. (2008). Assessment of synthetic milk exposure to children of selected population in Uttar Pradesh, India. *Indian Journal of Med Res*, 7, 22–34.
9. CSE report (2013). *Adulterated milk is what Indians are drinking*. <http://www.cseindia.org/content/adulterated-milk-what-indians-are-drinking> (accessed on November 23, 2015).
10. Deogade, A.H., Zanjad, P.N., Raziuddin, M. and Rathod, K.S. (2007). Study on physico-chemical quality of milk samples available in Parbhani city. *Veterinary World*. 6(4), 101-102.



11. Faraz, A., Lateef, M., Mustafa, M.I., Akhtar, P., Yaqoob, M. and Rehman, S. (2013). Detection of adulteration, chemical composition and hygienic status of milk supplied to various canteens of educational institutes and public places in Faisalabad. *Journal of Animal Plant Science*, 23(1), 119–24.
12. FDA. (2009). *Public meeting on economically motivated adulteration*. Available from: <http://www.gpo.gov/fdsys/pkg/FR-2009-04-06/pdf/E9-7843.pdf>. (Accessed September 21, 2016).
13. Food Safety and Standard Authority of India FSSAI (2012). *Manual of methods of analysis of foods: milk and milk products*. Ministry of Health and Family Welfare, Government of India.
14. Food Safety and Standard Authority of India FSSAI, (2011). Ministry of Health and Family Welfare, Government of India, New Delhi.
15. Isalkar, Umesh (2015). *Most cases of milk adulteration in Pune*. Times of India (TOI), April 29, 2015.
16. Jain, Chandana and Mediratta, Rittu (2013). A study on the quality of milk in Gwalior. *Indianjournal.com*, 6(1), 93-94.
17. Kandapal, S. D., Srivastava, A. K. and Negi, K. S. (2012). Estimation of Quality of Raw Milk (Open & Branded) by Milk Adulteration Testing Kit. *Indian Journal of CommunityHealth*, 24(3), 188-192.
18. Keene, W. E. (1999). Lessons from investigations of food borne disease outbreaks. *Jama*, 281, Makadiya and Pandey 1845-47.
19. Lipp, M. and Moore, J. (2013). *Understanding food fraud, its impact on global supplies*. Available from: <http://www.fnbnews.com/article/detnews.asp?articleid=33596§ionid=32>. Accessed September 21, 2016.
20. Liu, J., Ren, A., Yang, L., Gao, J., Pei, L., Ye, R., Qu, Q. and Zheng, X. (2010). Urinary tract abnormalities in Chinese rural children who consumed melaminecontaminated dairy products: a population- based screening and follow-up study. *Canadian Med Association Journal*, 182(5), 439–42.
21. Mendes, Thiago Oliveira, Brenda Simas Porto, Maria Valenzuela Bell, Italo Tuler Perrone and Marcone Augusto Leal Oliveira (2016). Capillary zone electrophoresis for

- fatty acids with chemo metrics for the determination of milk adulteration by whey addition. *Food chemistry*. 213,647-653.
22. Moore, J.C., Spink, J. and Lipp, M. (2012). Development and application of a database of food ingredient fraud and economically motivated adulteration from 1980 to 2010. *Food Sciences*, 77(4), 108–16.
 23. Mu, L., Dawande, M. and Mookerjee, V. (2014). Improving the milk supply chain in developing countries: analysis, insights, and recommendations. *Product operation Management*. 23(7), 1098–112.
 24. Rao, L.V., Ranganadham, M. and Rao, B.V.R. (2004). Quality of milk and milk products marketed in Hyderabad city. Part II- chemical quality of milk and fermented milks. *Indian Journal of Dairy Science*, 57(3), 171-176.
 25. Rupa Rani, Sharad Medhe, Raj, K.R. and Srivastava, M.M. (2012). High performance thin layer chromatography for routine monitoring of adulterants in milk. *National Academy Science Letters*, 35(4), 309-330.
 26. Saxena, G., Agrawal, M. (2004). Quality assessment of market milk available in Jaipur. *Indian Journal of Nutrition and Dietetics*, 41(8), 358-364.
 27. Shaikh, N., Soomro, A.H., Sheikh, S.A., Khaskheli, M. and Marri, A. (2013). Detection of adulterants and their effect on the quality characteristics of market milk. *Pakistan Journal of Agricultural Engineering and Vet Nery Sciences*, 29(2), 175–83.
 28. Shrishti, Nirwal and Rakesh Pant (2013). Analysis of milk quality, adulteration and mastitis in milk samples collected from different regions of Dehradun. *International Journal of PharmTech Research*, 5(2), 359-364.
 29. Singh, J.P. and Singh, D.B. (2008). Chemical quality of milk supplied by different agencies in Shikohabab town - a case study. *Indian Dairyman*, 60(2), 53-57.
 30. Singuluri, H. and Sukumaran, M.K. (2014). Milk Adulteration in Hyderabad, India – A Comparative Study on the Levels of Different Adulterants Present in Milk. *Journal of Chromatograph Separation Techniques*, 5(1), 1-3. <http://dx.dio.org/10.4147.21577064.1000212>. (Accessed April 08, 2016).
 31. Sinha, Kounteya (2012). 70 percent of milk in Delhi, country is adulterated. *Times of India*.

32. Soomro, A.A., Khaskheli, M., Memon, M.A., Barham, G.S., Haq, I.U., Fazlani, S.N., Khan, I.A., Lochi, G.M. and Soomro, R.N. (2014). Study on adulteration and composition of milk sold at Badin. *International Journal of Res. Applied Natural Social Science*, 2(9), 57–70.
33. Souza, S.S., Cruz, A.G., Walter, E.H.M., Faria, J.A.F., Celeghini, R.M.S., Ferreira, M.M.C., Granato, D. and Santana, A.D.S. (2011). Monitoring the authenticity of Brazilian UHT milk: a chemometric approach. *Food Chemistry*, 124(2), 692–95.
34. Spink, J. and Moyer, D.C. (2011). Defining the public health threat of food fraud. *Journal of Food Science*, 76(9), 157–63.
35. Stancati, Margherita (2012). Most Indian milk adulterated. *The Wall Street Journal*. <http://www.reuters.com/article/us-india-milk-idUSTRE80919O20120110> (accessed on January 10, 2012).
36. Xiu C. and Klein, K.K. (2010). Melamine in milk products in China: examining the factors that led to deliberate use of the contaminant. *Food Pol*, 35,463–70.
37. Yadav, K. Rajeev, Yadav, B.K. and Yogindra Kumar, M.P.S. (2008). Nature of adulteration and its extent in market milk. *Progressive Agriculture*, 8(1), 109-110.

Media reports regarding milk adulteration:

BBC News

1. BBC News. January 22, 2009. Chinese milk scam duo face death. Available from: <http://news.bbc.co.uk/2/hi/asia-pacific/3648583.stm>. Assessed on April 09, 2016.
2. BBC News. April 22, 2004. China 'fake milk' scandal deepens. Available from: <http://news.bbc.co.uk/2/hi/asia-pacific/7843972.stm>. Assessed on April 09, 2016.
3. BBC News. January 02, 2004. China babies die 'from fake milk'. Available from: <http://news.bbc.co.uk/2/hi/asia-pacific/8478195.stm>. Assessed on April 09, 2016.
4. BBC News. January 02, 2004. Baby bug threat from formula milk. Available from: <http://news.bbc.co.uk/2/hi/asia-pacific/3641475.stm>. Assessed on April 09, 2016.



Zee News

1. Zee News. May 30, 2015. Milk vendor gets 6 months jail for adulteration. Available from: http://zeenews.india.com/news/uttar-pradesh/milk-vendor-gets-6-months-jailfor-adulteration_1604444.html. Assessed on April 09, 2016.
2. Zee News. December 15, 2014. Food and Drug Administration lunches drive to check milk adulteration. Available from: http://zeenews.india.com/news/india/fda-launchesdrive-to-check-milk-adulteration_1602852.html. Assessed on April 09, 2016.
3. Zee News. May 27, 2015. Laws to prevent food, milk adulteration to be made stringent. Available from: http://zeenews.india.com/news/india/laws-to-prevent-foodmilk-adulteration-to-be-made-stringent_1515043.html. Assessed on April 09, 2016.
4. Zee News. November 11, 2014. Milk adulteration: Supreme Court asks centre to consider amending law. Available from: http://zeenews.india.com/news/india/milkadulteration-sc-asks-centre-to-consider-amending-law_1497376.html. Assessed on April 09, 2016.
5. Zee News. December 5, 2013. Make milk adulteration punishable with life imprisonment: SC. Available from: http://zeenews.india.com/news/nation/makemilk-adulteration-punishable-with-life-imprisonment-sc_894533.html. Assessed on April 09, 2016.
6. Zee News. August 2, 2013. Give kits to dairies to detect milk adulteration: High Court to government. Available from: http://zeenews.india.com/news/maharashtra/givekits-to-dairies-to-detect-milk-adulteration-hc-to-govt_866349.html. Assessed on April 09, 2016.
7. Zee News. May 30, 2015. Supreme Court ask state governments to curb sale of adulterated milk. Available from: http://zeenews.india.com/news/nation/sc-asksstate-govts-to-curb-sale-of-adulterated-milk_859321.html. Assessed on April 09, 2016.
8. Zee News. October 28, 2012. High Court quashes conviction of 19 year old milk adulteration case. Available from: http://zeenews.india.com/news/delhi/hc-quashesconviction-in-19-year-old-milk-adulteration-case_808007.html. Assessed on April 09, 2016.



9. Zee News. Supreme Court notice to centre, states over milk adulteration. Available from: http://zeenews.india.com/news/nation/sc-notice-to-centre-states-over-milkadulteration_774185.html. Assessed on April 09, 2016.
10. Zee News. May 9, 2012. Milk adulteration: High Court issues notices to Maharashtra government, centre. Available from: http://zeenews.india.com/business/news/economy/milk-adulteration-hc-issuesnotices-to-maha-govt-centre_37724.html. Assessed on April 09, 2016.
11. Zee News. January 25, 2012. Milk in Delhi clean: Delhi govt. to High Court. Available from: http://zeenews.india.com/business/news/economy/milk-in-delhiclean-delhi-govt-to-hc_37723.html. Assessed on April 09, 2016.
12. Zee News. January 25, 2012. Milk adulteration High Court issues notices to Maharashtra Government. Available from: http://zeenews.india.com/news/nation/milk-adulteration-hc-issues-notices-to-mahagovt_754800.html. Assessed on April 09, 2016.
13. Zee News. January 11, 2012. Delhi High Court notice to government on milk adulteration. Available from: http://zeenews.india.com/news/nation/delhi-hc-noticeto-govt-on-milk-adulteration_751941.html. Assessed on April 09, 2016.
14. Zee News. January 11, 2012. Now food samples found adulterated after milk. Available from: http://zeenews.india.com/news/nation/now-food-samples-foundadulterated-after-milk_751916.html. Assessed on April 09, 2016.
15. Zee News. January 10, 2012. Health ministry Delhi Milk Scheme to meet over milk adulteration. Available from: http://zeenews.india.com/news/nation/health-min-dmsto-meet-over-milk-adulteration_751733.html. Assessed on April 09, 2016.

Times of India (TOI):

1. TOI. December 30, 2015. Gutter fate for adulterated milk and ghee. Available from: <http://timesofindia.indiatimes.com/city/agra/Gutter-fate-for-adulterated-milk-andghee/articleshow/50385700.cms>. Assessed on April 10, 2015.
2. TOI: August 24, 2015. Milk adulteration rackets busted. Available from: <http://timesofindia.indiatimes.com/city/mumbai/Milk-adulteration-racketsbusted/articleshow/48655940.cms>. Assessed on April 10, 2015.



3. TOI: March 1, 2016. 68% of milk adulterated, new kit to test in 40 sec. available from: <http://timesofindia.indiatimes.com/life-style/health-fitness/diet/68-of-milkadulterated-new-kit-to-test-in-40-sec/articleshow/51436948.cms>. Assessed on April 11, 2016.
4. TOI. June 30, 2016. Gang involved in adulteration of milk busted on NH 79, 4 held. Available from: <http://timesofindia.indiatimes.com/city/jaipur/Gang-involved-inadulteration-of-milk-busted-on-NH-4-held/articleshow/50781101.cms>. Assessed on April 11, 2016.
5. TOI. July 16, 2015. Stricter laws against adulteration of milk. Available from: <http://timesofindia.indiatimes.com/city/mumbai/Stricter-laws-against-adulteration-ofmilk/articleshow/48092823.cms>. Accessed on April 11, 2016.
6. TOI. March 16, 2016. Noida: Food department launches anti-adulteration drive ahead of Holi. Available from: <http://timesofindia.indiatimes.com/city/noida/Noida-Fooddepartment-launches-anti-adulteration-drive-ahead-ofHoli/articleshow/51428200.cms>. Accessed on April 11, 2016.
7. TOI. March 14, 2016. Food adulteration awareness programme held, website to be lunched soon. Available from: <http://timesofindia.indiatimes.com/city/visakhapatnam/Food-adulteration-awarenessprog-held-website-to-be-launched-soon/articleshow/51389513.cms>. Accesses on April 12, 2016.
8. Time of India (TOI), July 2 (2013): Supreme Court asks state government to curb sale of adulterated milk.