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Sadhana Ojha
Ph.D. scholar, Division of Livestock Products Technology, Indian Veterinary Research Institute, Bareilly, Izatnagar, Uttar Pradesh, India

Apoorva Argade
Department of Livestock Products Technology, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India, India

Kanti Raje
Ph.D. scholar, Division of Animal Nutrition, Indian Veterinary Research Institute, Bareilly, Izatnagar, Uttar Pradesh, India

Dhananjay Kumar
Ph.D. scholar, Division of Livestock Products Technology, Indian Veterinary Research Institute, Bareilly, Izatnagar, Uttar Pradesh, India

SS Ahlawat
Department of Livestock Products Technology, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India

Correspondence
SS Ahlawat
Department of Livestock Products Technology, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India

Importance of bovine milk in human diet and effect of adulterated milk on human health

Sadhana Ojha, Apoorva Argade, Kanti Raje, Dhananjay Kumar and SS Ahlawat

Abstract
Milk is one of the most nutritious and complete food, it is a mixture of fat, protein, carbohydrates, minerals, vitamins and other miscellaneous constituents dispersed in water in emulsion, colloidal and solution form. It is rich in high quality protein providing all essential amino acids, fat especially essential fatty acids, most of the mineral and vitamins. Thus milk as a nutrient has the main function in human diet, especially for children. Along with milk, consumption of dairy products is also related with beneficial health effects beyond its pure nutritional value. Some malpractices which are done in case of liquid milk *i.e.* adulteration with water, neutralizer and preservatives which causes the deleterious effect on human health. Apart from adulteration it should be maintain the quality of milk in terms of contamination with hazardous microorganisms. Now a day's food safety of milk has been challenged.

Keywords: Bovine milk, fresh, adulteration, human health

Introduction
Milk and its products (dairy products) have long traditions in human nutrition. The importance of milk is reflected in the book "The World Peace Diet: Eating for Spiritual Health and Social Harmony written by Tuttle [1]. It is the most diversified food stuff in terms of composition as it provides body building proteins, bone forming minerals, health giving vitamins and energy giving lactose and fat. Milk is also prime source of important trace elements *i.e.* copper, zinc, manganese and iron, which play vital role in many physiological functions in human body [2]. The performance of Indian dairy sector over the last three decades has been extremely impressive, which is achieved by successful implementation of the Operation Flood programme along with development programmes of the State and Central Governments of India [3].

According to FAOSTAT [4], total milk production of the world is 816 million tonnes and milk production in India is estimated at 165.4 million tonnes, which is 18% of global milk production. The average annual growth rate of milk production has increased by 5.22%. Total milk contribution in India by Buffalo is 51% followed by 24%, 21% and 4% by crossbred cows, non-descript cows and goats, respectively. The per capita availability of milk is 355g, which is higher than the recommended level of ICMR which is 280g per day [5]. The result of increased share is because of rising population, expansion in herd size and improved productivity of milking animals. Uttar Pradesh is the largest milk producing state of India (l 24.193 MT) and contributing about 17.6% of total milk produced [6].

The history of Indian milk products is as old as Indian civilization. In India about 46% of the total milk produced is consumed in liquid form and 47% is converted into traditional products. These products are classified in to as heat cum acid coagulated products (chhana and paneer), heat desiccated products (khoa and rabri), cultured products (dahi and lassi) and fat rich products like ghee and makkhan [7]. In India, around 100 to 150 varieties of milk based traditional products are produced whereas only 7% of the milk goes into the production of western type products like milk powders, processed butter and processed cheese [8]. India has a unique pattern of production, processing and marketing/consumption of milk. Approximately 70 million rural households (primarily, small and marginal farmers and landless laborers) in the country are engaged in milk production, where over 11 million farmers are organized into about 0.1 million village Dairy Cooperative Societies with about 110 farmers per society. Out of total milk produced, about 50% is retained by the producers for domestic consumption leaving about 50% as marketable surplus.

The dairy industry handling the marketable surplus milk which is broadly divided into: organized sector and unorganized sector. The organized sector refers to the dairy units registered under the Milk and Milk Products Order, 1992. These dairies have capacity of handling 10,000 liters of milk per day or above and are registered as Co-operatives, Private or others like government dairies. The unorganized sector comprises of numerous small and /or seasonal milk producers/traders (popularly known as halwais) that are not registered under MMPO and handle less than 10,000 liters of milk per day. They are involved in selling raw and boiled liquid milk as well as selling mainly traditional milk products, usually at the local levels, but have a major share in Indian Dairy Industry. There are no official records on number of such unorganized dairy units however organized dairy sector procures around 30% of the marketable surplus i.e. around 15% of national milk production. Therefore, it is considered that unorganized sector handles about 70% of marketable milk.

The changing pattern of milk consumption, dynamic demography pattern, as well as rapid urbanization of rural areas along with the rise of population have contributed to a gap between demand and supply. Despite of this fact, the problem of milk deficiency escalate due to minimum availability of resources of land, labour, capital, inadequate cooling facilities, insufficient feeding of animals etc. As population is rising day by day, there is increased pressure on the land resources, availability of land for cultivation of food crops and fodder. All these factors contributed to certain malpractices. Milk adulteration is the most dangerous, hazardous practice in developing countries including India, Pakistan and Bangladesh.

Importance of milk in human life

Milk is chemically a complex mixture of fat, protein, carbohydrates, minerals, vitamins and other miscellaneous constituents dispersed in water [9]. Milk is one of the most nutritious and complete food. It is rich in high quality protein providing all essential amino acids, fat especially essential fatty acids, most of the mineral and vitamins. Meanwhile milk as a nutrient has the main role in human diet, especially for children [10, 11]. Consumption of dairy products is also associated with beneficial health effects beyond its pure nutritional value [12]. Cow's milk and milk products have played an important role in human nutrition. Fresh cow milk is reported to contain about 88% water [13]. It is a good source of low-cost high-quality protein, providing 8.1 grams of protein (16.3% of the daily value for protein) in one cup. Milk protein is a good source of bioactive peptides with various physiological effects [14].

Milk fat contains a wide range of carbonyl compounds and their precursor ketoglycerides as part of the delicate flavor system of milk fat. The monocarbonyl content of buffalo milk fat has been reported to be higher than that of cow milk fat [15, 16] while cow milk fat contains higher quantities of β-ketoglycerides (nearly twice) and methyl ketones than buffalo milk fat [15].

Table 1: Milk composition and percent contribution to the daily dietary reference intakes of some nutrients in 0.5 L whole milk and their main health effects [9]:

Component of milk	Concentration in milk	Percent contribution of 0.5 litter whole milk to reference intake	Health effects
Fat	33g/l		Energy rich
Saturated fatty acids	19g/l		Increase HDL, small dense LDL and total cholesterol, Inhibition of bacteria and virus
Oleic acid	8g/l		Prevent congestive heart failure, gives stable membrane
Lauric acid	0.8g/l		Antiviral and antibacterial
Myristic acid	3.0g/l		Increase HDL and LDL
Palmitic acid	8g/l		Increase HDL and LDL
Linoleic aicd	1.2g/l		Omega- 6 Fatty acids
Alpha linolenic acid	0.75g/l		Omega- 3 Fatty acids
Protein	32g/l	30-40%	Essential amino acids, bioactive protein, peptides, enhanced bioavaibility
Lactose	53g/l		Lactosylation products
Calcium	1.1g/l	40-50%	Bones, teeth, blood pressure, weight control
Magnesium	100mg/l	12-16%	For elderly asthma treatment
Zinc	4mg/l	18-25%	Immune function. Gene expression
Selenium	37ug/l	30%	Cancer, allergy, CHD
Vitamin E	0.6mg/l	2%	Antioxidant
Vitamin A	280ug/l	15-20%	Vission, cell differentiation
Folate	50ug/l	6%	DNA synthesis, Cell division, amino acid metabolisms
Riboflavin	1.83mg/l	60-80%	Prevent ariboflavinosis
Vitamin B_{12}	4.4ug/l	90%	Key role in folate meatabolism

Physicochemical properties of milk of different milch animals

Buffalo Milk

Buffaloes are generally distributed throughout Asia, the Middle East, Europe, China, South America, the former Soviet Union Countries, and the Caribbean. It is the second global milk-producing animal all over the world and India is the leading producer of buffalo milk. Buffalo milk plays a vital role in human nutrition particularly in the developing countries where malnutrition is a major concern. Apart from white color and smooth texture it is rich in terms of nutrients *i.e.* high levels of fat, lactose, protein, casein, and ash. Buffalo milk has 50% more protein than cow milk, 40% more energy in calories, nearly 40% more calcium and high level of natural antioxidant like Tocopherol. Buffalo milk has lower cholesterol content and is beneficial for cardiovascular system. Studies reveal that buffalo milk causes less milk allergy than cow's milk. Buffalo milk is thick and creamy

which is suitable for the manufacture of traditional indigenous milk products like khoa, dahi, paneer, kheer, payasam, malai, kulfi and ghee and ice-cream etc.

Buffalo milk contain a complex mixture of 75 volatile compounds, 50% of which were identified as esters, 14% as aldehydes, 13% as nitrogen compounds, 9% as ketones, 5% as aliphatic alcohols, 2.5% aromatic, and 4% sulfur compounds [17]. The viscosity of buffalo milk is generally higher than that of cow milk [18, 19].

Buffalo milk contains bioactive gangliosides not present in cow milk which shows a GM_1-specific binding to cholera toxin subunit B and anti-inflammatory activity [20]. Buffalo milk is characterized by a faster coagulation than cow [21, 22]. The pH of buffalo milk decrease more slowly than the pH of cow milk during acidification, due to higher buffering capacity of buffalo milk [23, 24] resulting from high casein and inorganic phosphate contents of buffalo milk.

The casein micelles of buffalo milk are larger and richer in minerals and can be disrupted by alkali at higher pH values than that of cow milk. El-Salam and El-Shibiny [25] observed high homologies between the proteins of buffalo milk and cow milk, but buffalo milk protein αs_1-casein and αs_2-casein had lower levels of phosphorylation. The freezing point or cryoscopic index of milk is related to its soluble constituents (i.e., lactose and soluble salts) and is usually used to detect water added to milk. Hofi *et al.* (1966) observed that the freezing point of buffalo milk (−0.518 °C to −0.590 °C) was less than that of cow milk. Haggag *et al.* [26] reported values of 1.036 and 1.032 for the specific gravity of colostrum and normal buffalo milk. Buffalo milk had a lower specific gravity of 1.014 and 1.028 in clinical and subclinical cases, respectively.

Cow Milk

According to Ayurveda, cow milk is nutritive and good for the vital organs. It possesses sweet taste (Madhura rasa) and is cooling (Sheetha veerya) in nature. Cow Milk promotes immunity and acts as rasayana and ojovardhaka. In the absence of mother's milk, cow milk has been suggested as a natural alternative for children having weak digestion and destitute immunity. It is ideally suited as a brain tonic according to Ayurveda because it has the ability to pacify Vata dosha which is responsible for the proper functioning of Nervous system. It has lower fat than buffalo milk and is rich in a variety of minerals, vitamins, and proteins. It is also an excellent source of calcium and phosphorus. It is beneficial for healthy bones, dental health, reducing obesity in children, protection from thyroid problems, and cardiovascular health. It can be used in making dairy products for example curds, sweets, cheese etc. Czerniewicz *et al.* [27] carried out a study on assessment of hygienic quality and physico-chemical properties of raw milk from Holstein-Friesian and Jersey cows. Milk from Jersey cows contained much higher levels of dry matter, which resulted primarily from higher concentrations of protein compounds (by approx. 19%), both casein whey proteins and fat (by approx. 50%), as compared with milk from Holstein-Friesians. The characteristics of dispersion state of fat globules showed that their average diameters were greater (by approx. 24%) in milk from Jersey cows, in comparison with milk from Holstein-Friesians, however levels of lactose and milk properties, *i.e.* acidity, density, conductivity and freezing temperature, were similar in both cow breeds.

Goat Milk

Goats are supposed to be the first farm animal to be domesticated. Goat is also known as poor men's cow because they have never been intensively farmed, that is why they are healthy, rarely suffer from mastitis. Being second largest in goat population, India also has some of the great milch breeds like Jamunapari, Beetal, Surti, Barbari. Goat milk is having better digestibility, alkalinity, buffering capacity and certain therapeutic values in medicine and human nutrition [28,29,30] in comparison to cow's or human milk. Goat milk contains beneficial lactic acid bacteria (*Lactococcus lactis lactis, Lactococcus lactis cremoris, Lactobaccilus, Leuconostoc*). It is responsible for production of several antimicrobial substances like bacteriocin and goat milk microbiota is also considered a good source of novel bacteriogenic *Lactic acid* bacteria (LAB) strains that can be exploited as an alternative for use as bio preservative in food [31]. Goat milk differs from cow or human milk in higher digestibility, distinct alkalinity, higher buffering capacity and certain therapeutic values in medicine and human nutrition [32, 33]. Fatty acids like caproic, caprylic and capric acids are reported to have great medicinal values for patients suffering from a variety of mal-absorption, childhood epilepsy, cystic fibrosis and gallstones [34].

Pfeuffer [35] identified conjugated linoleic acid as a potent anticarcinogen. Goat milk has higher content of monounsaturated, polyunsaturated fatty acids and medium chain triglycerides than cow milk [34]. Total peroxidase activity (associated with glutathione peroxidase) was 65% in goat milk as opposed to 29% for human and 27% for cow milk [36]. If a human infant's fed solely on goat milk, the infant is over supplied with protein, Ca, P, Vitamin A, thiamin, riboflavin, niacin and pantothenate in relation to the FAO-WHO requirements [37].

Adulteration practices in milk

Today Indian dairy sector is facing most serious problem of adulteration, which not only causes ill effects to human health even causes major economic losses to the dairy industry. National survey on public health concern conducted by FSSAI [38] has revealed that almost 70% of milk sold and consumed in India is adulterated by contaminants such as detergents, preservatives, skim milk powder etc, where as water is the most common adulterant followed by detergent. In the survey, 68% milk samples were found to be adulterated in which 31% came from rural areas. Of these 16.7% were packet or branded milk and rest were loose milk samples from dairies. In the urban areas, 68.9% milk was found to be adulterated with water, detergent, urea and skim milk powder [39]. Adulteration is done to compensate certain attributes of milk like water is added to increase the volume of milk, starch and flour as thickening agent, whereas skimmed milk powder and whey powder are added to counter the dilution and extend the solids content of the milk. Other adulterants like vegetable oil, sugarcane or urea are used to compensate the fat, carbohydrate or protein content of diluted milk [40]. Some chemicals like hydrogen peroxide, carbonates, bicarbonates, antibiotics, caustic soda and even the most lethal chemical formalin are added to increase the shelf life of milk [41]. Milk adulteration is an act of intentionally debasing the quality of food offered for sale either by admixture or substitution of inferior substances or by the removal of some valuable ingredients [42].

Liquid milk has been an important human nutrient source for thousand years. However, the food safety of milk has been

challenged in recent years by illegal adulterants such as water, neutralizers, and melamine and so on [43, 44]. The extensive consumption of milk and dairy products makes these foodstuffs targets for potential adulteration with financial gains for unscrupulous producers [45]. Milk adulteration is an act of intentionally debasing the quality of food offered for sale either by admixture or substitution of inferior substances or by the removal of some valuable ingredients [42]. Milk can be adulterated by addition of water, neutralizers to mask acidity, salt or sugar to mask extra water or high solid contents, whey, hydrogen peroxide etc. [46]. Food safety and food security is very much on top of agenda in India, so it is important to screen the quality of milk and milk products in market. Several factors like adulteration, presence of antibiotic, insecticides and pesticides residues and seasonal changes affect the physico-chemical properties and composition of milk [47].

Quality and safety of milk and its effect on human health

Quality milk means, the milk which is free from pathogenic bacteria and harmful toxic substances, free from sediment and extraneous substances with good flavour and normal composition, adequate in keeping quality and low in bacterial counts [48]. The natural thiocyanate content of milk is an important constituent for the activity of the lactoperoxidase/H_2O_2 system in the preservation of milk. The average natural thiocyanate content of raw buffalo milk varies from 5.90±2.17 and 8.94±4.54 mg/l in the morning and evening milk from individual buffaloes [49]. Fresh milk easily deteriorates to become unsuitable for processing and human consumption [50]. Raw milk often contains microorganisms which may cause food borne diseases [51-53]. Pathogens that have been involved in food borne outbreaks associated with the consumption of milk include *Listeria monocytogenes, Salmonella spp., Escherichia coli and Staphylococcus aureus.* The presence of these pathogenic bacteria in milk has emerged as a major public health concerns, especially for these individuals [54]. Mubarack *et al.* [55] and Lingathurai and Vellathurai [56] reported the presence of pathogenic bacteria to be a major threat to public health especially for those individuals who still consume raw milk. The presence of bacteria in raw milk reduces the keeping quality of milk and certain bacteria with their associated enzymes and toxins may even survive pasteurization creating health hazards [57].

Conclusion

Milk is the most diversified food stuff in terms of composition because it provides body building proteins, bone forming minerals, health giving vitamins and energy giving lactose and fat. It is also a prime source of essential trace elements *i.e.* copper, zinc, manganese and iron, which play essential role in many physiological functions in human as well as animal body. But the consumption of poor quality milk may lead to deleterious effect on human health. Consequently, consumers must be more careful against milk adulteration to eradicate this malpractice followed by local dairy owners, consumers which is deeply rooted in cities. It is also important to have a quality control system and stringent implementation of FSSAI standards for regular check to ensure that only good quality milk to sell.

References

1. Tuttle W. "The World Peace Diet: Eating for Spiritual Health and Social Harmony. Lantern Books, New York, A Division of Booklight Inc, 2005.
2. Ojha S, Pathak V, Goswami M, Bharti SK, Singh VP, Singh T. Quality and safety assessment of cow' milk in different regions of Mathura city. Nutri Food Sci. 2017; 47(3):443-455.
3. Khamkar SK. The Consumption Pattern of Dairy Products by Indian Consumers since 2000. Asian J Manage Sci. 2014; 2(3):170-172.
4. FAOSTAT. 2016 http://faostat.fao.org/default.aspx.
5. DAHD. http://dahd.nic.in/Division/statistics/animal-husbandry-statistics-division. 2017.
6. DAHD. http://dahd.nic.in/Division/statistics/animal-husbandry-statistics-division. 2014.
7. Dharmpal. Technological advances in the manufacture of heat desiccated traditional. Ind. dairy man. 2002; 52(10): 27-35.
8. Jayalakshmi, Senthilkumar. A Study on Principles and Performance of Dairy Products Marketing Promotion in India with Special Reference to Tamilnadu State. Indian J Res. 2014; 3(10):172-178
9. Haug A, Hostmark AT, Harstad OM. Bovine milk in human nutrition a review. Lipids in Health and Dis. 2007; 6:25.
10. Hassan IP. Quality Assurance of Various Dairy Products. MSc Thesis, Department of Chemistry, University of Peshawar, Pakistan, 2005.
11. Enb A, Aboudonia MA, Abd-rabou NS, Abouarab AAK, El-Senaity MH. Chemical composition of raw milk and heavy metals behavior during processing of milk products. Global Veterinarian. 2009; 3:268-275.
12. Silanikove N, Leitner Gm, Merin U, Prosser CG. Recent advances in exploiting goat's milk: quality, safety and production aspects. Small Rumin. Res. 2010; 89:110-124.
13. Kataoka K, Nakae T, Imamura T. Comparative studies on the milk constituents of varous mammals in Japan. Japan J Dairy Sci. 1991; 20:222-232.
14. Clare DA, Swaisgood HE. Bioactive milk peptides: a prospectus. J Dairy Sci. 2000; 83:1187-1195.
15. Bhat GS, Ramamurthy MK, Rao MB. Carbonyl compounds in cow and buffalo milk fat. J Dairy Sci. 1981; 64:588-593.
16. Ahmed NS, Abou Dawood AE, Ghita EI, Abd El-Gawad IA, Abas FA. Carbonyl compounds of fresh buffaloes and cows butter oil. Egypt J Dairy Sci. 1984; 12:173-177.
17. Moio L, Dekimpe J, Etrevant PX, Addeo F. The neutral volatile compounds of water buffalo milk. Ital J Food Sci. 1993; 5:43-56.
18. Ismail AA, El-Deeb SA. Effect of heat processing, storing and homogenization on the viscosity, opacity and stability of cow and buffalo milks. Zeit Leben Untersch Forsch. 1973; 152:202-207.
19. Tambet RV, Sirinivasan MR. Changes in surface tension, viscosity and tension of buffalo and cow milk during Cheddar cheese manufacture. Ind. J Dairy Sci. 1979; 32:173-176.
20. Colarow L, Turini M, Teneberg S, Berger A. Characterization and biological activity of gangliosides in buffalo milk. Biochim Biophys Acta. 2003; 1631:94-106.
21. Ibrahim MKE, Amer SN, El-Abd MM. A study on some factors associated with the rate of coagulation of diluted milk. Egypt J Dairy Sci. 1973; 1:109-116.
22. El-Shibiny S, Abd El-Salam MH. The role of colloidal calcium in rennet coagulation of milk. Egypt J Dairy Sci. 1980; 8:35-40.

23. Imam A, Shazly AE, Abdou S. Buffer value, pKa and buffer intensity curves of buffalo's cow's, ewe's and goats milk. Milch wissenschaft. 1974; 29:597-598.
24. Ahmad S, Gaucher, Rousseau F, Beaucher E, Piot M, Grongnet JF, Gaucheron F. Effect of acidification on physicochemical characteristics of buffalo milk: a comparison with cow milk. Food Chem. 2008; 106:11-17.
25. El-Salam MH, El-Shibiny S. A comprehensive review on the composition and properties of buffalo milk. Dairy Sci. Technol. 2011; 91(6):663-699.
26. Haggag HF, Hamzawi LF, Mahran GA, Ali MM. Physico-chemical properties of colostrums, clinical and subclinical mastitic buffalo milk. Egypt J Dairy Sci. 1991; 19:55-63.
27. Czerniewicz CK. Comparison of some physicochemical properties of milk from holstein-friesian and jersey cows. Pol J Food Nutr Sci. 2006; 15(56):61-64.
28. Haenlein GFW, Caccese R. Goat milk versus cow milk. In: G.F.W. Haenlein and D.L. Ace (Eds.) Extension Goat Handbook. USDA Publ., Washington, DC, E-1, 1984, l-4.
29. Park YW, Chukwu HI. Trace mineral concentrations in goat milk from French-Alpine and Anglo-Nubian breeds during the first 5 months of lactation. J Food Composit Anal. 1989; 2:161-169.
30. Park YW. Hypo-allergenic and therapeutic significance of goat milk. Small Rumi. Res. 1994; 14:151-159.
31. Perin lm, Nero la. Antagonistic lactic acid bacteria isolated from goat milk and identification of a novel nisin variant lactococcus lactis. BMC Microbiol. 2014; 12:14-36.
32. Park YW, Chukwu HI. Macro-mineral concentrations in milk of two goat breeds at different stages of lactation. Small Rumin. Res. 1989; 1:157-166.
33. Park YW. Relative Buffering Capacity of goat milk, cow milk and soy milk based infant formulae and commercial non preservative antacid drugs. J Dairy Sci. 1991, 3326-3333.
34. Haenlein GFW. Proceedings of the Fifth International Conference on Goats, vol. II, Role of goat meat and milk in human nutrition. Indian Council of Agricultural Research Publishers, New Delhi, India, 1992, 575-580.
35. Pfeuffer M. Funktionelle Wirkung konjugierter Fettsaeuren. In: Hanf, C.-H. (Ed.), Vortraege zur Hochschultagung, Schriftenreihe der Agrar- und Ernaehrungswissenschaftlichen, Fakultaet der Universitaet Kiel, Heft, Germany, 2000; 90:171-179.
36. Debski B, Picciano MF, Milner JA. Selenium content and distribution of human, cow and goat milk. J Nutr. 1987; 117:35-46.
37. Jenness R. Composition and characteristics of goat milk: Review. J Dairy Sci. 1980; 63:1605-1630.
38. FSSAI. Food Safety and Standard Authority of India, National Survey on Adulteration of Milk, New Delhi India, 2011, 1-13.
39. Nirwal S, Pant R, Rai N. Analysis of Milk Quality, Adulteration and Mastitis in Milk Samples Collected From Different Regions of Dehradun. Int J Pharm Technol Res. 2013; 5(2):359-364.
40. Fakhar HF, Law F, Walker G. The white revolution - dhoodh darya. Pak dairy development comp, 2006, 72.
41. Tariq MA. A close look at dietary patterns. http://www.dawn.com/2001/11/05/ ebr13.html, Accessed Feb, 2011.
42. FDA (Food and Drug Administration). https://www.fda.gov/downloads/food/ guidanceregulation/.../milk/ucm513508.pdf, 1995.
43. Balabin RM, Smirnov SV. Melamine detection by mid and near infrared (MIR/NIR) spectroscopy: A quick and sensitive method for dairy products analysis including liquid milk, infant formula, and milk powder. Talanta 2011; 85:562-568.
44. Santos PMD, Wentzell PD, Pereia-Filho ER. Scanner digital images combined with colour parameters: A case study to detect adulterations in liquid cow's milk. Food Analytical Methods. 2012; 5:89-95.
45. Nicolaou N, Xu Y, Goodacre R. MALDI-MS and multivariate analysis for the detection and quantification of different milk species. Annual Biannual Chem. 2011; 399:3491-3502.
46. Kartheek M, Smith AA, Muthu AK, Manavalan R. Determination oadulterants in food: A review. J Chemical and Pharma Res. 2011; 3:629-636.
47. Bashir S, Awan MS, Khan SA, Rathore HA, Qureshi MA, Kathu ZH. An evaluation of milk quality in and around Rawalakot, Azad Kashmir. African J Food Sci. 2013; 7(11):421-427.
48. Khan MTG, Zinnah MA, Siddique MP, Rashid MHA, Islam MA, Choudhury KA. Physical and Microbial Qualities of Raw Milk Collected from Bangladesh Agricultural University Dairy Farm and the Surrounding Villages, Mymensingh-2202. Bangl J Vet Med. 2008; 6:217-221.
49. Abd El-Ghani S, Sayed AF. Natural thiocyanate content and optimum conditions for activation of lactoperoxidase system in raw buffalo milk. Egypt J Dairy Sci. 1997; 25:241-252.
50. Food and Agricultural Organization (FAO). The Lactoperoxidase System of Milk Preservation. Regional Lactoperoxidase Workshop in West Africa. Burkina Faso, 2001, 17-19.
51. Adesiyun AA, Webb L, Rahman S. Microbiological quality of raw cow milk at collection centres in Trinidad. J Food Prod. 1995; 58(4):448.
52. Steele ML, Mcnab WB, Poppe C, Graffiths MW, Chen S, Degrandis SA *et al*. Survey of Ontario bulk tank milk for food borne pathogens. J Food Prot. 1997; 60(11):1341-1346.
53. Headrick ML, Korangy S, Bean NH, Angulo FJ, Altekruse SF, Potter ME *et al*. The epidemiology of raw milk associated food borne disease out breaks reported in the United States. American J Public Health. 1998; 88(8):1219-1221.
54. Ryser ET. Public health concerns. In Marth EH, Steele JL. (Eds.), Appl Dairy Microbiol. Marcel decker, inc., New York, 1998, 263-403.
55. Mubarack MH, Doss A, Dhanabalan R, Balachander S. Microbial quality of raw milk samples collected from different villages of Coimbatore district, Tamilnadu, South India. Ind J Sci Technol. 2010; 3(1):61-63.
56. Lingathurai S, Vellathurai P, Ezil Vendan S, Prem AA. A comparative study on the microbiological and chemical composition of cow milk from different locations in madurai, tamil nadu. Ind J Sci Tech. 2009; 2:2
57. Salman AM, Iman MH. Enumeration and identification of coliform bacteria from raw milk in Khartoum State, Sudan. J of Cell and Animal Bio. 2011; 5:121-128.