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Effect of Adulteration in Milk Concerning with Human Health in India

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Abstract

The dairy industry is one of the leading and massive contributors to the Indian economy. Milk and its related products are an integral part of human life because it is always needed from a lactating child to an adult and old person. This is the reason that maintaining the quality of milk is necessary. The milk supply depends on two modes: unorganized (a farmer who supplies milk directly to the consumer) and the organized sector where the dairy industry maintains the supply chain with compliance with food safety concerns as per standard regulation. However, the Government of India via the Food Safety & Standard Authority of India (FSSAI) has prescribed separate standards to reduce adulteration in milk and milk products, in respect of which major adulterants i.e., urea, salt, sugar, vegetable Fats, detergents, soda, water, etc. have been identified as a serious concern for milk quality and safety. Most of the adulteration done in milk are carcinogenic and some other gives rise to several types of abdominal disorders. Due to this, a very large population may suffer serious side effects. Therefore, there should be strict compliance of quality standards and regular monitoring of quality at the local milk vendors and milk industries at a large level so that mankind can be saved from the health-related problems caused by adulteration.

Keywords: Milk, adulteration, milk quality, dairy industry, health effects.

Introduction

Being a prime farmer country, Dairying is an old tradition for millions of Indian rural households and domesticated animals have been an integral part of the farming systems from the civilization era. At that time several animals like cows, buffalo, goatsand sheep which are domesticated mainly for milk production, but they also benefited by plowing their field. People believe the traditional statement that milk provides four main things of life which are important for human beings i.e. dharma, earth, Kama, and moksha since the Vedic era. Description of milk is also found at the time of Ramayana and Mahabharata. In India, cow milk is used for many religious purposes like Pooja and Indian people also worship cows and are called “GayeMata”. In previous times, Indian people use milk mainly in the form of Doodh, Dahi and Ghee. Milk contributes more to the national economy than any other farm commodity more than 10.5 billion dollars in 1994-95 (*Dairy India* 1997). In the context of poverty and malnutrition, milk has a special role to play for its many nutritional advantages as well as providing supplementary income to some 70 million farmers in over 500,000 remote villages (*Dairy India* 1997). More importantly, the farmers earn an average of 27.3 percent of their income from dairying, with as high as 53 percent for landless and as low as 19 percent for the large farmers in India. Milk is a complex biological fluid secreted from the mammary glands of mammals that meets the nutritional needs of neonates of the species from which the milk is derived. It supplies nutrients like proteins, fat, carbohydrates, vitamins, and minerals in moderate amounts in an easily digestible form and provides bodybuilding vitamins along with furnishing energy-giving lactose and many other nutrients, therefore an ideal food for pregnant females and infants. Milk can provide a wide range of readily available nutrients to maintain health and normal growth of the body. Due to its nutritive value, milk is significant to young and old people. So it is the best and cheapest source of nutrition and an article of a daily diet, easily accepted and used by all the age groups in rural as well as in urban area.

The milk of different species slightly varies in composition and properties but contains the same constituents in general. On average, milk is made up of 87.4% water and 12.6% milk solids (3.7% fat, 8.9% milk solids-not-fat) among milk solids-not-fat contain protein (3.4%), lactose (4.8%), and minerals (0.7%) (Chandan, 1997).

Milk fat often called “butterfat” is commercial, the most valuable constituent of milk. It is also of great importance from the standpoint of the food value of the milk. The protein of milk is an extremely important class of naturally occurring that are essential to all life processes; milk proteins represent one of the greatest contributions of milk to human nutrition. The nitrogen-containing portion of milk can be divided into three broad fractions: casein 80% (dominant class proteins in milk), whey protein18-20% and non-protein nitrogen 0.05 - 0.07% (NPN) (Rowland, 1938). Carbohydrate is also an essential component present in milk, providing principal energy to an infant and human when it consumes as a form of liquid

milk or products. The average content of milk carbohydrates is 4 -5% Carbohydrate of milk is mainly lactose (milk sugar), which constitutes more than 80% of total carbohydrate in milk.

Milking is a process by which milk is drawn from the mammary gland either by hand or by a milking machine. A couple of decades ago it was ok for someone to have touched a food item with his bare hands but today it is not only risky but also could be extremely dangerous and yet almost 95% of the milk in India is manually milked, exposing the milk to all forms of human hygienic as well as contagious contamination. The present need in India is to implement milking be done by milking machine which is normally designed and constructed according to recognized standards that avoid the introduction of contaminants into milk. Before milking, the proper cleaning of udder, hand and milking equipment can help for obtaining good quality milk. In a general way the maximum chance of contamination in milk from milking point when it is done in expose environment because milk serves as an ideal medium for the growth of various microorganisms by which milk contaminated and spoilage. These microorganisms cause may be beneficial or harmful effects on humans. Beneficial microbes reported in milk are lactic acid bacteria like Streptococcus *spp.*, *Lactobacillus spp.*, and some others. Pathogenic microbes in milk reported are *Staphylococcus aureus*, *Listeria monocytogens, Salmonella spp. Clostridium spp.* and *Bacillus spp.* They are also called food-borne pathogens which cause food borne diseases.

Milk supply from point of production to endpoint at the consumer, which belonging may be villages, town, and large cities. Therefore, a chain is created from production to consumer is divided into two main sectors, first is an unorganized sector covered by the milkmen (dodhias) and the second organized sector belongs to the dairy industry. A large part of total milk production is supplied by the unorganized sector and a small amount is going through the dairy industry, which processed packed milk available in the market. The milkmen distribute milk within 2-5 hours after milking while the distribution of milk by industry is a time-consuming process for at least 1-2 days. But the quality point of view milk of dairy industry is better than non-processed milk supplied by dodhias.

Main problems are created in the delivery system which affects the milk quality. Therefore, after milking the milk handling, storage, and transport of milk should be conducted in a manner that will avoid contamination and minimize any increase in the microbiological load of milk. In India, the proper handling, storage, and transport of milk are important elements of the system of controls necessary to produce safe and suitable milk and milk products. Generally, the contamination sources of milk are air, water, and unclean storage equipment, the health of animals, the unhygienic environment of the shed, and herders which affects the milk quality. Special need in India, milk collected, transported in the fully sterilized environment, and delivered without undue delay by which we can save the milk from spoilage.

In the delivery system, storage temperature plays an important role. If the temperature is increased, the growth of microorganisms also increases. Some of the developed European

countries have specified a standard, that the milk fit for consumption cannot have bacteria above 50, 0000 per milliliter. At a higher environmental temperature, bacteria in the milk grow rapidly. Considering Indian conditions, most milk stored in open containers in the natural environmental condition is not fit for consumption within 9 minutes after milking and the average time that the milk takes to reach homes is much longer.

Although milk is produced throughout the year yet the supply and demand of milk are related to the seasonal fluctuations in India. In the case of milk, there are three seasons classified- Lean, Mean, and Flash, which are based on the available amount of milk. However, milk production is greatly reduced during the summer months (lean season) due to heat stress scarcity of fodder, etc. So that season demand for milk is high, and the supply of milk is low. Milk is transported from point of production to consumer in two different ways - organized (dairy industry) and non-organized (milkmen). In the Indian scenario as per the government of India admission, more than 70% of the milk available in India does not conform to Food Safety Standards Association India (FSSAI) standards. Millions of parents in our country today trust this milk for their children. Such milk is watered or skimmed to increase the amount of milk to increase their profit and cover up the high demand and in this situation, they (supplier) maintain its composition starch, flour, urea, cane sugar, vegetable oil, etc., are added as adulterants and this activity called adulteration. Milk is a perishable commodity so during the summer months, it is likely to be spoiled during transportation. The middlemen (supplier) therefore add chemical preservatives such as penicillin, streptopenicillin, formaldehyde, hydrogen peroxide, sodium bicarbonate, detergent, etc. The major problem in the fluid milk supply system in India from the consumer point of view is not only adulteration but also dirty adulteration.

The purpose of adulteration is to maintain milk freshness and market value which in turn is harmful to the consumer leaving them clueless of what direct effect these adulterants have on them.

Water is an adulterant in milk which is often always added to increase the volume of milk which in turn decreases the nutritive value of milk which if contaminated poses a health risk, especially to infants and children. Detergents are added to emulsify and dissolve the oil in water giving a frothy solution, the characteristic white color of milk. Detergents cause gastrointestinal complications. Urea is added to milk to provide whiteness, increase the consistency of milk, and for leveling the contents of solid-not-fat (SNF) as are present in natural milk. The presence of urea in milk overburdens the kidneys as they must filter out more urea content from the body. Hydrogen Peroxide is also added to milk to prolong its freshness, but peroxides damage the gastrointestinal cells which can lead to gastritis and inflammation of the intestine.

The dairy market is very much fragmented and government involvement is limited. Soon because of all the changes the dairy chain itself will change. The pace of the change is a multi factorial issue mostly depending on the government, government rules, and their

implantation. Food safety and food security are very much on top of the agenda in India and they will remain soon as food and feeding this huge population is crucial for the sustainable growth of this ancient culture.

The public consumes fluid milk which has been adulterated and diluted to an extent that there is very little nutritive value left in it, resulting, to a great extent, in general, in public health concerns and malnutrition.

Dairy farming and Indian tradition

Dairying is a centuries-old tradition for millions of Indian rural households; domesticated animals have been an integral part of the farming systems from time immemorial. Milk contributes more to the national economy than any other farm commodity more than 10.5 billion dollars in 1994-95 (*Dairy India* 1997). In the context of poverty and malnutrition, milk has a special role to play for its many nutritional advantages as well as providing supplementary income to some 70 million farmers in over 500,000 remote villages (*Dairy India* 1997). More importantly, the farmers earn an average of 27.3 percent of their income from dairying, with as high as 53 percent for landless and as low as 19 percent for the large farmers.

The dairy industry in India

The dairy industry in India has been on a steady path of progression since Indian independence in 1947. It has grown from producing 17 million tons of milk in 1951 to producing 121 million tons in 2011. Today, India is the largest milk-producing country in the world. This solid progress is primarily attributable to structural changes in the Indian dairy industry brought about by the advent of dairy cooperatives. The Indian dairy industry reported market size of USD 48.5 billion for 2011. With a Compound Annual Growth Rate (CAGR) of 16 percent, it is anticipated to reach USD 118 billion in 2017 (NDDB yearly report 2013). On the back of a rise in disposable income, coupled with strong demand for dairy products, the Indian dairy industry is set to experience high growth rates in the next five years.

Historically the milk-producing animals have been domesticated for thousands of years. Initially, they were part of the subsistence farming that nomad engaged in. As the community moved about the country their animal accompanied them. In the more recent past, people in agricultural societies owned dairy animals that they milked for domestic and local (village) consumption. In this case, the animal was normally milked by hand and the herd size was quite small so that all of the animals could be milked in less than an hour about 10 per milkier and day to day the area of milk production was increased with industrialization and urbanization, so that way the supply of milk became a commercial industry, with the specialized breed of cattle being developed for dairy, as distinct from beef or drought animals. According to the increasing population in the world, the establishment of dairy also

increases and improvement of animal breed continuing in process in all developed and developing countries all over the world for more production of milk. Description of milk in Indian culture is found in the Vedic era, at the time of Ramayana, where statement said to the birth of four sons of Raja Dasrath when kheer (a milk product) was consumed by three queens of the king. At the time of Mahabharata Lord Krishna was famous as Gwala and makhana chore.

India is changing rapidly in aspects of life. The effect of westernization is one of the main factors responsible for societal changes, mostly related to living standards, changing diets, and accordingly change of product lines in the retailers. There are about 1.22 billion people in India, with around 120 million cows & buffalos. Apart from that, there is a long chain of milk production and consumption (based on small units), cooperative structures, and a tradition of selling milk over the country in the street, a large amount of milk consumed fresh. Most of the population belongs to rural areas in comparison to urban areas.

Pyramid

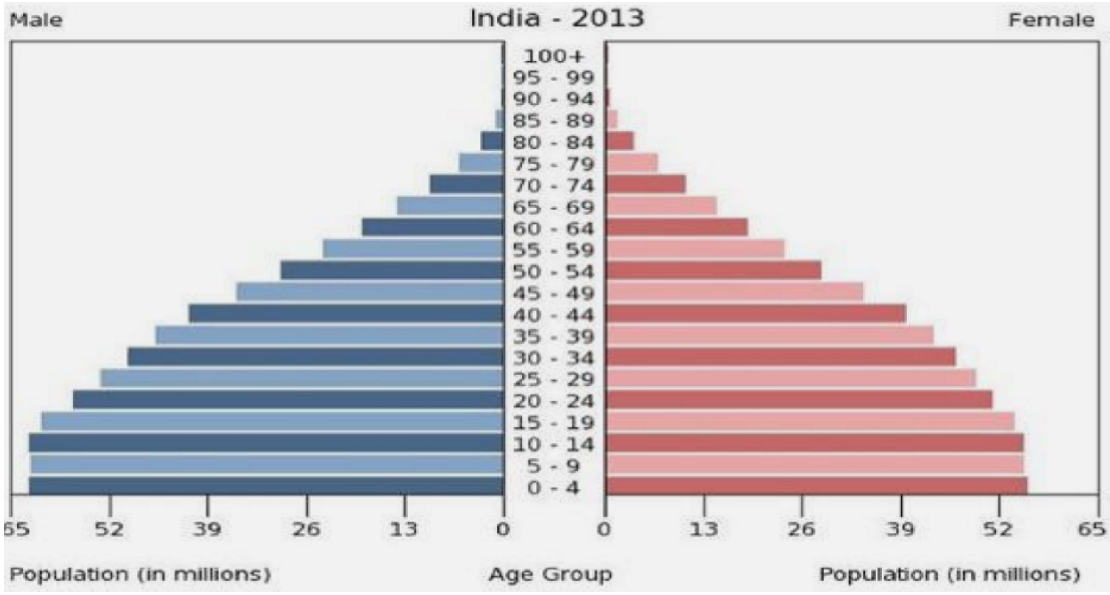


Figure 1.Indian Population

Commercial milk Productivity in India

Annual milk production in India has more than tripled in the last three decades, rising from 21 mil-lion tons in 1968 to an anticipated 80 million metric tons in 2001. This rapid growth and modernization are largely credited to the contribution of dairy co-operatives under the Operation Flood (OF) Project, assisted by many multi-lateral agencies including the European Union, the World Bank, Food and Agriculture Organization (FAO), and World Food Program (WFP). Despite the impressive growth in milk production in the last three decades, the produc-tivity of dairy animals remains very low (Table Productivity of milk by Zone1995-96) and milk-marketing systems primitive. Currently, more than 80 percent of the

milk produced in the country is marketed by unorganized sectors and less than 20 percent by the organized sector. The organized sector involves government and co-op-eratives; the unorganized sector involves private organizations.

Marketing of most of the milk through unorganized sectors is likely to dissuade small dairy farmers from expanding production, which is abso-lutely necessary to keep up with the strong demand growth. In a recent study, (Datta and Ganguly, 2002) estimated Indian milk demand for 2020 under vari-ous GDP growth rates. The study reported that if the current growth continues for the next twenty years (the nation has been growing at a rate between 5 and 7 percent over the past five years), milk consumption is likely to more than double by 2020. (Status of India U.P. table, annual table by NDDB)

Year	*Production (million tonnes)*	*Per capita availability (grams/day)*
1950-51	17.0	124
1960-61	20.0	124
1973-74	23.2	112
1980-81	31.6	128
1990-91	53.9	176
2000-01	80.6	220
2001-02	84.4	225
2002-03	86.2	230
2003-04	88.1	231
2004-05	92.5	233
2005-06	97.1	241
2006-07	100.9	246
2007-08	104.8	252
2008-09	112.2	266
2009-10	116.4	273
2010-11	121.8	281
2011-12	127.9	291
2012-13 (anticipated)	133.8	300

The importance of dairying in a country like India hardly needs emphasizing. India has vast resources of livestock, which play an important role in the national economy and the socio-economic development of millions of rural households. India has one of the largest stocks of cattle and buffaloes: more than 50 percent of the world's buffaloes and 20 percent of its cattle. The Indian dairy sector contributes a large share of the agricultural gross domestic product (GDP). Although the contribution of agriculture and allied sectors to the national GDP has declined during the past few decades, the contribution of the livestock sector has increased

from less than 5 percent in the early 1980s to over 6 percent in the late 1990s. Milk and milk products constitute a major share of the value of output from the livestock sector; their share increased from less than 50 percent in 1950 - 51 to about 65 percent in the late 1990s.

During the 1950s and 1960s, India was one of the largest importers of dairy products, importing over 40 percent of milk solids in the total throughput of the dairy industry. The commercial import of milk powder reached its peak at about 53 thousand tons in 1963 - 64

(Kanitkar, 1999). This concerned policymakers and a decision was made to achieve self-sufficiency in milk production. The major step forward, which has had a far-reaching impact, came in the midsixties with the establishment of the National Dairy Development Board (NDDB) to oversee dairy development in the country. The Operation Flood (OF) program, one of the world's largest and most successful dairy development programs, was launched in 1970; its main thrust was to organize farmers' cooperatives in rural areas and link them with urban consumers. Operation Flood has led to the modernization of India's dairy sector and has created a strong network for procurement, processing, and distribution of milk by the cooperative sector. In 1989, the Government of India launched the Technology Mission on Dairy Development (TMDD) program to support and supplement the efforts of Operation Flood and to enhance rural employment opportunities and income generation through dairying.

India is currently the largest producer of milk in the world, overwhelmingly thanks to the output of millions of smallholder farms. The OF cooperative movement has been important in dairy marketing in different parts of the country and undoubtedly has played an important role in keeping smallholders involved with this fast-growing sector. During the past three decades, milk production in the country has increased from about 22 million tons in 1970-71 to 84 million tons in 2001- 02 (GOI, 2003). The per capita availability of milk, which had decreased during the pre-OF period, not only kept pace with the growing population but increased from 107 grams in 1970 to 220 grams in 2000- 01.

Milk is the lacteal secretion produced from the mammary glands of the mammals and an exclusive healthy food for both infants as well as for adults (Nickerson, 1999). Milk in its natural form has high food value. It supplies nutrients like proteins, fat, carbohydrates, vitamins, and minerals in moderate amounts in an easily digestible form. Due to its nutritive value, milk is significant to young and old people. The varieties of milk differ in chemical composition, odor, and taste but they all contain the essential elements which are required for the maintenance of life. The nutrients in milk are the building materials necessary for growth and cannot be replaced by any other food (Talwar and Srivastava, 2003).

Nutritive aspects of Milk

Milk is the best and cheapest source of nutrition and an article of a daily diet, easily accepted and used by all the age groups in rural as well as in urban areas. It provides an appreciable

amount of fats and protein and also provides body building vitamins along with furnishing energy-giving lactose and many other nutrients, therefore an ideal food for pregnant females and infants. Milk can provide a wide range of readily available nutrients to maintain health and normal growth of the body. Milk has no pronounced taste which is slightly sweet to most persons. Any pronounced is abnormal. Freshly drawn milk has a characteristic, but not very pronounced, odor that is quite volatile and which practically disappears when the milk is exposed to the air (Eckels *et al*. 1951).

Milk in its natural form has high food value. It supplies nutrients like proteins, fat, carbohydrates, vitamins, and minerals in moderate amounts in an easily digestible form. Due to its nutritive value, milk is significant to young and old people.

Constituent	Buffalo Milk (%)	Cow Milk (%)
Water	84.2	86.6
Fat	6.6	4.6
Protein	3.9	3.4
Lactose	5.2	4.9

Milk contains more than 100 substances that are either in solution,suspension or emulsion in water, the important being casein - the major protein of milk, lactose - milk sugar, whey and mineral salts(Ali et al,2011; Altaf et al,2007; Kandpal et al,2012).

The term “milk” is a lay term for “cow’s milk.” It isa colloidal suspension of hydrophobic fat molecules suspended in a hydrophilic carrier of water, sugars, protein, and minerals. It is a secretion from the mammary glands of mammalian animals, and may also contain beneficial proteins (antibodies) necessary for a newborn’s survival. The main carbohydrate in milkis lactose; the main protein is casein (an allergen), and the major fats contain the fatty acids oleic and palmitic. In whole milk, most of the measurable acidity comes from the casein content and to a lesser degree the phosphate content (Deibel et al., 2005).

Although slightly varies in composition and properties, the milk of different species contains the same constituents in general. On average, milk ismade up of 87.4% water and 12.6% milk solids (3.7% fat, 8.9% milk solids-not-fat). The milk solids-not-fat contain protein (3.4%), lactose (4.8%), and minerals (0.7%) (Chandan, 1997). Milk fat often called “butterfat” is commercial, the most valuable constituent of milk. It is also ofgreat importance from the standpoint of the food value of the milk. The agreeable flavor of rich milk and to a large extent of other dairy products is largely due to the milk fat. Milk lipids are a major source of energy for new born animals and humans. They occur as fat droplets, which contain many non-polar lipids surrounded by a polar milk lipid globule membrane, with the droplets dispersed in the aqueous milk serum. Milk fat includes compounds with a wide range of chemical structures that are classified as lipids due to their solubility in non-polar organic solvents and their low solubility in water. Main fatty acids are present in triacylglycerols,

diacylglycerols monoacylglycerols and phospholipids. Small concentrations of free fatty acids also occur in fresh milk. Milk proteins are an extremely important class of naturally occurring compounds that are essential to all life processes. They perform a variety of functions in living organisms ranging from providing structure to reproduction. Milk proteins represent one of the greatest contributions of milk to human nutrition. The old way of grouping milk proteins was into casein, albumin, and globulin. The modern system for grouping is into casein (80%), whey (serum) proteins (17-18%), and minor proteins including fat globule membrane protein.

Lactose, a disaccharide sugar made up of glucose and a galactose molecule, has been widely used for various purposes in the pharmaceutical and food industries. Being physically and chemically inert, lactose thus becomes a good supplement in many drug formulations. Anhydrous lactose maybe employed as an excipient, filler, diluent, diuretic drug, and a bulking agent in a wide variety of pharmaceutical preparations (Ferrari *et al.*, 2004and Martindale, 1996). Moreover, it is intensively used as a nutrient and multifunctional ingredient in infant formulas, geriatric, dietetic, and health foods (American Academy of Pediatrics, 1985).

From a nutritional point of view, milk offers many gains. One ofthe main arguments of raw milk proponents is that heating reduces the nutritional value of milk, milk being a good source of proteins (essential amino acids), fat (unsaturated fatty acids), vitamins and minerals (Claeys et al,2013).

The nutritional value of food not only depends on the nutrient content but also on the bioavailability and the contribution of these nutrients to the recommended daily intake (RDI). As such, the nutritional value of milk proteins depends on their digestibility and their contribution to the intake of essential amino acids. Approximately80% of the milk proteins consist of casein (as1, as2-, b- and kcasein).Casein molecules are precursors of several bioactive peptides, with antimicrobial activity and vector properties for calcium, zinc, copper, iron and phosphate ions in the body (Ferencik, & Krajcovic, 2008). Bioactive peptides are short amino acid chains that are inactive in the native protein, but have a physiological effect in the body after liberation by e.g. digestive enzymes or processing (Høstmark, & Harstad, 2007; Rantamäki, & Tupasela, 1998; Schanbacher, & Murray, 1997).

Adulterations in milk and milk products

Milk quality is a worldwide issue. The consumer has demanded a better quality product so it is the dairy producers and dairy industry's obligation to meet that request. All consumers have choices and if the dairy industry does not meet their needs, they will buy other products.

Milk quality is dependent on three key areas. These areas are the milking routine, the cows and their environment, and the milking equipment. I refer to the interaction of these three

areas as the "Mastitis Triangle." A common reason why many milk quality programs fail is people fail to look at all three areas together and all causes of the problems are not identified.

The milking routine is critical to the production of quality milk. People need to clearly understand there are huge economic differences between different regions of the USA so the significance of quality milk can be different in all these areas. In my opinion, money should not be the driving force to producing quality milk because research has clearly shown herds with lower SCC do make more profit by the production of more milk. Under most circumstances, the milking routine can be the key reason for the production of quality milk. The secret is to make sure everyone on the dairy farm clearly understands the importance of a consistent milking routine and implements this routine at every milking. On most of the dairy farms that I consult with, fine-tuning the milking routine is necessary to get to the new level of milk quality everyone wants. To have success in changing a milking routine, you have to implement procedures that clearly demonstrate the need for change. When the milkers can clearly understand the need for change, they are much more likely to succeed in the implementation of any change.

Quality and evaluation

When evaluating a dairy during milking, the most important factor to take concern is the consistency of the milking routine. Having a milking routine that everyone can follow at every milking is very important. Once you have evaluated milking practices long enough to understand their normal routine, the next thing to look for is timing. After milking the handling of milk under hygienic conditions and storage, transportation is done in a proper way according to dairy and food safety standards.

Recent studies have clearly demonstrated that regardless of which region of the country a dairy farm operates, there are definite economic benefits to having a good milking routine with the right timing. Their studies showed the ideal lag time from the start of the milking routine to unit attachment was 60 seconds. On many of the dairies I consult at, there is a wide variation in lag time depending on who is doing the milking and many of the cows do not have adequate let down prior to unit attachment. One of the hardest things to accomplish on a dairy is to develop a milking routine that everyone understands and can easily follow. Many of the milkers have milked at various other farms and tend to utilize the skills they had acquired from those farms. It is not uncommon to see three or four different routines on each farm. Some researchers try to look at the advantages of each routine and then develop a routine that gives the dairy the best of what is already being done and will lead to better milking performance and milk quality.

Storage and hygiene assurance

The health of the dairy herd, milking and pre-storage conditions are also basic determinants of quality (Aumaitre, 1999). Another source of contamination by microorganisms is unclean

teats. However, in the present study, the bacteriological counts in milk due to unclean udders were low but intense manipulation of small quantities of milk using several containers increased the count of microflora in milk. The use of unclean milking and transport equipment contributed also to the poor hygienic quality of the milk. These observations are in line with findings in Ethiopia (Godefay and Molla, 2000).

Microbial interactions

A major factor determining milk quality is its microbial load. It indicates the hygiene practiced during milking, like the cleanliness of the milking utensils, condition of storage, manner of transport as well as the cleanliness of the udder of the individual animal (Spreer 1998; Gandiya 2001). Milk from a healthy udder contains few bacteria but it picks up many bacteria from the time it leaves the teat of the cow until it is used for further processing. These microorganisms are indicators of both the manner of handling milk from milking till consumption and the quality of the milk. Milk produced under hygienic conditions from healthy animals should not contain more than 5 x 10^5 bacterial/ml (O'Connor 1994).

Microbial contamination of raw milk may occur from 3 main sources: from within the udder (mastitis associated organisms), from environmental organism transfer via dirty udder and teat surfaces, and from improperly cleaned and sanitized milking equipment. Additionally, improper cooling and prolonged storage of milk can also influence bacterial count by increasing the rate of bacterial growth during storage of milk (Elmoslemany *et al.*, 2009).

The mean value of total bacterial count in the barn air was 1.73 x 103with minimum of 1.5 x 102 and maximum of 2.1 x 104. Earlier study (Matkovic *et al.*, 2006) reported the mean value of total bacterial count in the barn air ranging from 2.82 × 104 CFU/m3 at noon to 7.76 × 104 CFU/m3 in the evening in Croatia. Total airborne bacterial count has been reported to be directly influenced by air temperature, relative humidity and air flow velocity, and also could be attributed to daily animal and human activities in the barn (Matkovic *et al.*, 2006) whereas, the outdoor air bacterial emission depends on the source of contamination, position of air outlet on the barn roof or wall, ground configuration, air flow, air temperature, humidity and sunlight (Matkovic *et al.*, 2006).

The presence of bacteria in barn air is a natural phenomenon, their primary source being the animals themselves, then the fodder and humans. Bacteria are only one of the many groups of air pollutants. Bacterial count mayalso depend on the construction and technical characteristics of the housing, the number of animals kept in the housing, temperature, and humidity in the housing, and feeding, grooming, milking, and other activities (Lange *et al.*, 1997; Seedorf *et al.*1998).

Bacterial count in the air of a dairy barn may provide appropriate data on the hygienic condition at the farm from where milk starts on its way to the consumer. In addition, for the assessment of the effect of dairy barns on thelocal environment, bacterial count in the barn air

and monitoring of its emission from the barn to the adjacent environment are important parameters (Matkovic *et al.*, 2006). Seasonal changes in airborne fungi, bacteria and in the incidence of *S. aureus* resistance to antibiotics at dairy cattle concentrated animal feeding operation has been reported in the southwest United States (Alvarado *et al.*, 2009). High spore counts can occur at the dairy farm and feed and milking equipment can act as reservoirs or entry point for potentially highly heat-resistant spores into raw milk (Scheldeman *et al.*, 2005).

The detection of coliform bacteria and pathogens in milk indicates possible contamination of bacteria either from the udder, milk utensils or water supply used (Bonfoh *et al.*, 2003). Fresh milk drawn from a healthy cow normally contains a low microbial load (less than 1000 ml-1), but the loads may increase up to 100 fold or more once it is stored for sometimes at normal temperatures (Richter *et al.*, 1992). However, keeping milk in clean containers at refrigerated temperatures immediately after the milking process may delay the increase of initial microbial load and prevent the multiplication of micro organisms in milk between milking at the farm and transportation to the processing plant (Adesiyun, 1994; Bonfoh *et al.*, 2003). Contamination of mastitis milk with fresh clean milk may be one of the reasons for the high microbial load of bulk milk (Jeffery and Wilson, 1987).

In the early days of the development of the commercial dairy industry, milk was produced under much less sanitary conditions than are used today, and cooling was slow and inadequate to restrict bacterial growth. Developments during the first half of the twentieth century created significant reductions in the rate of spoilage of raw milk and cream, by making it possible for every-other-day pickup of milk from farms and shipments of raw milk over long distances with minimal increases in bacterial cell numbers. Rapid cooling and quick use of raw milk are accepted as best practices and can affect the spoilage ability of *Pseudomonas* spp. present in milk. Pseudomonads that had been incubated in raw milk for 3 days at 7◦C (44.6◦F) had greater growth rates and greater proteolytic and lipolytic activity than those isolated directly from the milk shortly after milking (Jaspe, Oviedo, Fernandez, Palacios, &Sanjose,1995).

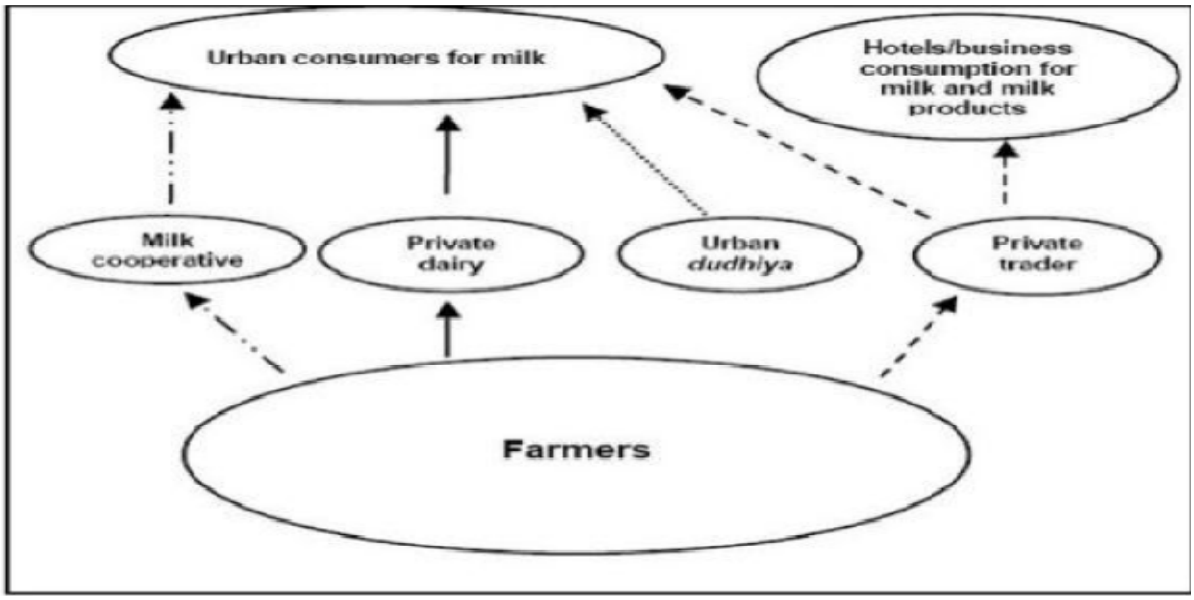
The current research includes all the independent **f**actors that are able to affect the food safety level of the end product of the whole dairy chain, i.e.**,** the consumed fluid pasteurized milk. Transportation between the stages is also considered, i.e., transport of raw milk to the processing factory, and delivery of pasteurized milk to the sale unit (retailer/catering establishment).

Due to the overpopulation and rapid urbanization, the demand of milk production is rapidly increasing. Almost70% people use raw milk in India which is in poor hygienic conditions. Raw milk is not only of poor keeping quality than heat treated but also carries the risk of microbial pathogens causing variety of diseases in man. For example, Q fever is the rickettsial disease transmitted to man through the raw milk (Sutherland *et al*, 1986).

The existing status of milk supply marketing indicates that milk is predominantly marketed through the highly fragmented unorganized sector. The organized dairy industry, which accounts for less than 20 percent of total milk production, comprises government and co-operatives. Within the organized sector, the co-operative sector is by far the largest in terms of volumes of milk handled. (Rajendran and Mohanty, 2014).

The dairy co-operatives in India are a three-tier structure following the Anand Pattern, including village-level milk-producers' co-operative societies, district-level milk-producers' co-operative unions, and state-level milk-producers' co-operative federations. Dairy co-operatives provide inputs, animal health-care, and extension services to the society members and also train employees of the village- and district-level dairy co-operatives.

The major constraint in milk marketing is the involvement of the unorganized sector. Changing the dairy-cooperative laws and regulations can reduce the unorganized sector's role in milk marketing. Strengthening the infrastructure for milk collection, transportation, processing, packaging, pricing, and marketing through dairy co-operatives can also change the minds of the milk producers. Producers are not receiving a remunerative price for their produce because of the presence of middlemen in milk marketing. By reducing the number of middlemen between producer and consumer, the consumers' share to the producer can be increased. In other words, bridging the gap between the producer and the consumer can increase the producer's share. Producers' bargaining power and the lack of proper infrastructure for transportation, distribution, and storage are other constraints that make milk procurement difficult. Furthermore, it future challenges in milk marketing are mainly concerned with quality, product development, infrastructure-support development, and global marketing. We can overcome these challenges by strengthening the dairy co-operatives (Flowchart of the supply chain in India)



A very broad spectrum of milk is a cover-up by an unorganized sector; milkmen (doodhies) and open dairy shop in the local market, they have less facility for proper storage temperature, and hygiene conditions, and thus the quality of milk is affected during the delivery system. Apart of milk quality is also affected due to the careless handling of packed milk by general storekeeper. To produce milk products conforming to high-quality standards, it is important that milk should be collected, transported, and cooled immediately under strict hygienic conditions. Ideally, all the milk leading to the dairies should be bulk cooled. Possible cooling at DCS will decrease a load of microorganisms (Scheldeman *et al*., 2005).

Quality management on dairy farms becomes more and more important regarding the different areas of animal health, animal welfare, consumer health and food safety. Monitoring animals, farm conditions and farm records can be extended with risk identification and risk management (Aumaitre, 1999). The hazard analysis critical control point system is useful as an on-farm strategy to control the product as well as the production process in the areas of animal health, consumer health and food safety aspects.

A major cause of the failure of processing and packaging systems is the development of biofilms on equipment surfaces. These communities of microorganisms develop when nutrients and water remain on surfaces between times of cleaning and reuse. Bacteria in biofilms (sessile form) are more resistant to chemical sanitizers than are the same bacteria in suspension (planktonic form) (Mosteller & Bishop, 1993).Chemical sanitizers may be rendered ineffective by biofilms leaving viable bacteria to be dislodged into the milk product (Frank & Koffi, 1990).

Concern for humanity

Although milk is produced throughout the year yet the supply and demand of milk are related to the seasonal fluctuations in India. Milk production is usually high in the winter season from January to April while its demand is less during this season. The demand for milk is at its highest during summer and production is less. To compensate for this gap, many adulterants are used in milk for the purpose of preservation and to enhance the quality of milk, to increase the quantity, to attract the customer, to improve the lactometer reading. Glucose, cane sugar, urea and ammonium sulfate and other substances have been encountered as additives for the purpose of masking the effects of dilution with water (Farani, 1983).

Adulterants used in milk

The adulteration of milk is banned due to its ill effects. Carbonate in milk produces gastrointestinal problems including gastric ulcer, diarrhea, colon ulcer and electrolytes disturbance (Beall and Scofield, 1995). The hydrogen peroxide disturbs the antioxidants in the body disturbing the natural immunity hence increasing aging (Clare *et al*. 2003). Chloride in the milk disturbs the acid-base balance in the body and also blood pH (Hu and Murphy, 2004). Ammonia in milk develops regression, loss of acquired speech and sensory

disturbances. Here are a few examples of what adulterants can be added to milk in order to maintain its freshness and market value which in turn is harmful to the consumer leaving them clueless of what direct effect these adulterants have on them. Water is an adulterant in milk, which is often always added to increase the volume of milk, decreasing the nutritive value of milk that, if contaminated, poses a health risk, especially to infants and children. Detergents are added to emulsify and dissolve the oil in water giving a frothy solution, the characteristic white color of milk. Detergents cause gastrointestinal complications. Urea is added to milk to provide whiteness, increase the consistency of milk and for leveling the contents of solid-not-fat (SNF) as are present in natural milk. The presence of urea in milk overburdens the kidneys as they have to filter out more urea content from the body. Hydrogen Peroxide is also added to milk to prolong its freshness, but peroxides damage the gastrointestinal cells which can lead to gastritis and inflammation of the intestine. Starch is also used as an adulterant and if high amounts of starch are added to milk this can cause diarrhea due to the effects of undigested starch in the colon. Its accumulation in the body may prove very fatal for diabetic patients. Carbonates and bicarbonates are added to milk too, this can cause disruption in hormone signaling that regulates development and reproduction (http://mohfw.nic.in).

Conclusion

In concluding remark after this study, India where Milk is a complete food naturally with a lot of nutritional and economic value which plays an important role in different foodstuffs. The major problem in the milk supplied by milkman system in India, from the customer point of view, is its poor quality and adulteration. Packed milk is considered, generally, as high quality, hygienic milk but no published literature is available regarding the chemical composition and especially the chemical adulterants in packed milk available commercially in local markets. So that adulteration of milk and milk products are prove to be a serious concern for health and environment of humanities. It also affects the economy of the country.

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