

## Common Milk Adulteration in Developing Countries Cases Study in China and Sudan: A Review

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### Abstract

Food adulteration is a bigger problem faces the world and developing countries are higher risk related with this problem due to lack of good monitoring and policies. Milk in natural form has a high food value; it comprises nutrients, which are essential for proper growth and maintenance of the human body. Recently, there has been an upsurge in milk consumption worldwide, especially in developing countries, and consumption of milk is now forming a significant part of the diet for a high proportion of the global population. As a result of the most increased demands, high growth in competition in the dairy markets and increasing complexity of the supply chain, some unscrupulous milk producers are indulging in milk fraud. This malpractice has become a big common problem in the developing countries. Milk is often subjected to fraud (by means of adulteration) for lack of proper hygienic conditions of processing storage or financial gain, transportation and marketing. Water is the most common adulterant used which dilute and decreases the nutritional value of milk. If the water is contaminated, for example, with pathogens or chemicals, this poses a big serious health risk for consumers. To the diluted milk, inferior cheaper materials may be added such as milk powder, cane sugar and urea, even more hazardous chemicals including melamine, caustic soda, formalin, and detergents. These additions have the potential to cause serious health-related problems. This review aims to shows the impacts of milk fraud on nutrition and food safety in developing countries especially China and Sudan.

**Keywords:** Adulteration; Milk; Water; Urea; Hydrogen Peroxide; Developing countries

### Introduction

Food adulteration is a serious issue which has needed to investigate as a potential food safety and public health concern in recent years [1]. Food fraud for economic gain has been prevalent throughout history for as long as food has had economic value as commodities. Economically motivated adulteration, a subset category of food fraud, was defined in 2009 by the Food and Drug Administration (FDA) [2] 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,” and can often encompass effects public safety through the unknown addition of allergens, toxins, and hygienic risks [3].

Now-a-days it is very common to hear or read news about the food items being adulterated and such products are being openly sold out and are consumed by people, which cause various health hazards. News has shown how milk and milk products are being adulterated with urea, soap and other hazardous chemicals [4,5].

Milk is defined as the clean, whole, fresh, lacteal secretion obtained by the complete milking of one or more healthy milk animals excluding that obtained within (15) days before or (5) days after the calving or such period as may be necessary to provide the milk practically colostrums free and containing the minimum prescribed percentage of sold not fat and milk fat [6].

Milk is a dynamically balanced mixture and a perishable food. It is one of few foods consumed in the natural form throughout the world. Milk contains 87% water, 3.3% protein, 3.9% fats, 5% lactose and 0.7% ash. Milk supply body with building protein, health giving vitamins, bone forming minerals, and energy supplying lactose and milk fat. Besides providing certain essential fatty acids it includes all essential amino acid. All the properties of milk make it an important food for adults, growing children, adolescents, invalid, convalescents and patients [7].

Milk is an important source of nutrients required for growth of infants and children and for health maintenance in adults. Milk is perfect food, readily digested and absorbed. It is chiefly valuable source of good quality fat, protein, carbohydrates, vitamins and minerals. Protein required for growth of infants and children. It is also required for maintenance of tissues in adults [8].

The extensive consumption of milk and dairy products makes these foodstuffs targets for more potential adulteration with financial gains for unscrupulous producers [9].

Adulteration of milk and other dairy products has existed from old times. That is why it was necessary to stipulate regulatory standards against adulteration in food and develop methods or tests to detect adulteration particularly adulteration of milk with cheaper and sometimes toxic chemicals is matter of serious concern [10].

Milk is adulterated either intentionally or accidentally during production and processing of milk. Harding et al. [11] stated that there are many potential adulterants in liquid milk, such as neutralizers, salt,

sugar, water, or solid contents. Borin et al., [12] reported adulteration of powdered milk in Brazil and mentioned that the most frequent contaminants were starch, whey, and sucrose that range from 20-25%, which does not cause detectable flavor changes. But occasionally contaminant ratio may be as high as 60%. In Taiwan, the media showed that an adulteration ratio of 30% reconstituted milk in fresh milk has been found.

Normally the adulteration is done either for financial gain or lack of proper hygienic conditions of processing, storage, transportation and marketing. This ultimately leads to stage that the consumer is either cheated or often becomes victim of diseases. Adulteration is very common in developing countries. It is evenly important for the consumer to know the common adulterants and their effects [8].

One of the oldest and simplest forms of milk adulteration is through the addition of variable volumes of water to increase its volume for greater profit; this can substantially decrease the nutritional value of milk, and if the water added is contaminated there is a high risk to human health because of potential waterborne diseases [13]. Sellers adulterate milk with water because it is cheap rather than starch which may be homogenized and obviously can be detected and discovered by the consumer (Adam. 2009).

In raw milk, chemical like formalin, hydrogen peroxide, boric acid and antibiotics are added to increase the shelf life [14].

The other kind of adulteration of milk by the additions of starch, rice flour, skim milk powder, reconstituted milk, urea, melamine, salt, glucose, vegetable oil, animal fat and whey powder. These additions is to increase the thickness and viscosity of the milk, and to maintain the composition of fat, carbohydrate and protein [15,16].

Some kinds of the adulteration, their impact on the health of human body are discussed in the following sections:

### **Water**

Water is the most common adulterant in milk [16]. The major percentage of natural milk contains water (87%), but milk with added water is a serious concern. In one hand it decreases the nutritious value; on the other hand chemicals are added to compensate the density and colour after dilution with water. Since addition of water is the easiest way and cheap source for adulteration of milk.

### **Urea**

The common milk adulterant to increase the shelf life is addition of urea to milk, [7,17-19]. Urea is also used to prepare synthetic milk and increase the SNF value. The average content of urea in cow milk is about 50 mg/100 ml (average). Urea content in milk may also increase due to unbalanced feeding of cows, [18,19]. It is also used for heat stability [20]. Health hazards associated are acidity, indigestion, ulcers and cancers. Urea is harmful to heart, liver and kidneys [17] especially for kidneys as the kidneys have to do more work to remove urea from the body [13]. This necessitates the importance of detection of urea in milk.

### **Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>)**

So to increase the shelf life, addition of chemical preservatives in branded milk [21] is a very common practice. Sometimes hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) is used as a preservative [22]. These additions have the potential to cause serious health-related problems.

Milk adulteration has been widely reported in developing countries such as Sudan, Pakistan, Brazil, India, and China [8,15,23-25].

### **Adulteration Milk in China**

China is the largest livestock producer and consumer in the world. China has more than 400 million cattle, sheep and goats, fresh milk and dairy products such as yogurt is increasing rapidly and is strongly encouraged by the Chinese Government to improving national health- especially for the elderly and the young through schemes such as the School Milk Program. Milk and dairy product consumption is increasing 10% annually. Post forecasts 2016 milk production at 38 million tons, a slightly high from USDA's 2015 estimate, reflecting the increased number of dairy cows. Improved genetics from imported live dairy cows helped increase milk production per animal [26].

China has displayed rapid growth in dairy production in recent decades. There are variations in milk production and consumption levels between urban and rural areas and between regions, which in this case may be accredited to historical differences and cultural preferences. Approximately 85% of China's milk is produced in North China, which has the most suited climate and high availability of feed materials. The fact is 60% of the human population lives in the South of the country creates difficulty in matching production with demand. Moreover, urban areas have a higher milk consumption than rural areas, which is probably due to the fact that much of the larger milk operations are in the bigger cities, such as Shanghai and Beijing, so there is greater availability in these areas. While per capita consumption is increasing rapidly, it still remains comparatively low [27]. The rapid growth of the sector has led to new challenges and has exceeded the ability of value chains to maintain the safety of the products as illustrated by the melanine scandal in year 2008 (Animal Production and Health Commission for Asia and the Pacific and Food and Agriculture Organization of the United Nations, Regional Office for Asia and the Pacific, 2009). Pei [28] link the problems of melanine contamination to the rapid and unregulated development of the sector.

In China milk dealer's water down milk due to high demand and limited supply. Then add synthetic powders to increase the protein value, Hydrogen peroxide and gentamycin as preservatives, Vegetable oils to increase the fat value. Microbial contamination of milk was also high because only 20% of the small scale backyard farmers use disinfectants prior to milking. This decreases the shelf life of milk. This adulterated milk increased the number of patients with kidney stones [29].

### **Adulteration Milk in Sudan**

Animal resources in the Sudan comprise sheep, goat, cattle, camel, poultry and wild-game animals. Most of the animals in the Sudan are raised on natural pastures by nomadic tribes. In irrigated projects and the areas of mechanized farming animals feed on crops by-products. So, Sudanese animals are almost free from feed additives, hormonal and chemical residues, which give special preference to the Sudanese animal products. Food and agricultural organization (FAO, 2006) reported that the fresh milk produced in the Sudan was 7.1 tonnes from local Breeds and most of the yield (95%) is produced by nomads and 5% in urban area while the rearing cross bred cows about 500,000 head distributed in the towns and cities of the country and produce 95% milk yield produced in urban area of the total milk yield and this shows the potentiality of cross bred cows report [6].

In Sudan, milk is distributed through irregular marketing channels such as venders on donkeys or by cars in addition to collection centers and some consumers buy milk directly from the farms. These informal channels make milk uncontrollable and could influence the nutritional value of milk in case of adulteration [30].

Three hundred milk samples were collected from three different localities in Sudan and observed for adulteration with water, starch and the values of their total solids were also determined. It was found that more than 95% samples were found adulterated with water, 35.5% for starch. None of milk sample has total solids according to standard values [31].

Afrah [32] concluded that one third of the raw milk samples sold in Khartoum North were adulterated with formalin. Also the formalin persisted even after milk pasteurization [33-35].

Nahla [30] reported the adulteration of milk with the addition of water; it was obvious in milk samples obtained from Omdurman. Also mentioned that the adulteration of milk by water was recorded in milk samples distributed by venders on donkey.

## Conclusions

The high nutritional value of milk and its relative low cost compared with other protein sources has made it form a significant part of the diet of many populations worldwide. However, global increased demand has made milk prone to massive levels of fraudulent activity. Milk is a high-risk commodity of concern for fraudulent activities for financial gain whereby perpetrators may increase food safety hazards and diminish nutritional quality through intentional adulteration and/or malpractice under poor hygiene conditions, a lack of preservation, and no cooling facilities. Such types of fraud are becoming a common problem in many regions throughout the world, particularly in developing countries like India and Pakistan, which have largely unregulated practices. Milk used for human consumption can be adulterated with inferior, cheaper materials or hazardous chemicals, including pond water, reconstituted milk powder, cane sugar, urea, melamine, glucose, and detergents. Milk may be adulterated to such an extent that there is significantly less nutritional value and it may also be toxic for public health, as shown in recent milk fraud scandals. Thus, more analysis is essential to generate awareness among the public about malpractices or negligence in milk production. Also the consumer must be aware about the kind of milk he consumes, and the authorities should realize the importance of frequent inspection of the market to check whether this milk meets the minimum legal standards.

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