Adulterated Milk Used for Consumption in Thatta District of Sindh, Pakistan

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Citation

Abstract
Milk and milk based products are rich source of vital nutrients like fatty acids, amino acid vitamins and minerals which promote healthy living in human being regardless of any age group. Lack of interest of regulatory authorities in the developing countries such as Pakistan and India render theses adulterated; a technique which suppresses the health promoting ability of milk and dairy products and transforms it into hazardous and noxious effects. This opinion focuses on the aduleration and contamination of natural healthy items and tries to draw the attention of regulatory agencies to curb these malpractices and make sure that we do not cry over spoiled milk in the end. Thus the present study was carried to detect the aduleration in the market milk used for consumption in the Thatta district of Sindh, Pakistan. Hundred (100) market milk samples were collected each of twenty (n= 20) from milk producers, milk collectors, middlemen, processors and dairy shops from the vicinity of Thatta district. All the milk samples were brought in the Dairy Analytical Laboratory of Department of Animal Products Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam, Pakistan. Water was the most common adulterant found in the majority of milk samples observed in present study, followed by detergent, cane sugar, rice flour, caustic soda, salt, starch and dalda ghee, respectively. The percentage of extraneous water in milk samples collected from dairy shops, middlemen and milk collectors was remarkably higher compared to processors and milk producer. Significant difference was observed in freezing point of milk samples collected from all milk intermediaries and it goes towards zero. All the milk samples collected from dairy shops, middlemen and milk collectors were adulterated with water as compared to processors and milk producers. Except milk producers the extent of adulteration at all milk intermediaries was found higher.

1. Introduction

Milk is very precious food, freely digested and absorbed. It consists of nutrients, which are needed for proper growth and maintenance of body. Milk and milk products form a significant part of the diet and a substantial amount of our food expenditures goes on milk and other dairy products. Milk is transported from the point of production to consumers and processing plants by middlemen. Thus, they do not maintain proper hygienic conditions during this transport, which leads to increase the total viable
count. They also adulterate milk to increase their profit margin by several adulterants like urea, starch, flour, cane sugar, vegetable oils, detergents etc. Various preservatives like formalin, hydrogen per oxide, boric acid and some antibiotics are also added in milk to increase its shelf life. These adulterants, preservatives and drugs in milk cause very serious health related problems (Afzal et al., 2011). The extensive consumption of milk and dairy products makes these foodstuffs targets for potential adulteration with financial gains for unscrupulous producers (Nicolau et al., 2011 and Food & Drug Administration 1995). Adulterated food is dangerous for health as it may contain various toxic chemicals, it may be deprived of nutrients required for proper growth and development of human body (Marcus 1979). Although Pakistan has a good ranking among milk producing countries, milk production and distribution systems are still very traditional and underdeveloped. It is dominated mainly by the informal private sectors, consisting of various agents i.e. producers, collectors, middlemen, processors, traders, and dairy shops with each performing a specialized role at a particular point in the supply chain (Zia, 2006). Adulteration is a major problem in the fluid milk supply in Pakistan. Milk suppliers increase their profit from the sale of milk through dilution, extraction of valuable component (i.e. cream) and/or use of additives such as low quality flour to enhance the total solids content. Hence, the milk for consumption has been adulterated to such an extent that there is very little nutritive value left in it (Lateef et al., 2009). However, the adulteration of milk deteriorates the quality of milk, and may cause human health hazards, like gastroenteritis, nausea, vomiting, diarrhea, kidney damage, acute failure of circulatory system, Kidney failure, asthma, urticaria, metabolic acidosis, and convulsions in sensitive persons (Haasnoot et al., 2004; Beall and Scofield, 1995; Rideout, 2008; Ayub et al., 2007; Gwin et al., 2009; Mota et al., 2003; Saad et al., 2005; Li et al., 2009). Keeping in view the present study was designed to monitor various adulterants and to estimate the extent of extraneous water in the milk used for consumption in Thatta district of Sindh province.

2. Material and Methods

2.1. Collection of Milk Samples

An experiment was designed to detect the various adulterants in the market milk used for consumption at the vicinity of Thatta district of Sindh, Pakistan. A total of 100 unprocessed milk samples were collected each of twenty milk producers, milk collectors, middlemen, processors and dairy shop. All the milk samples were collected in sterilized glass bottle with cap, labeled, kept in icebox and immediately brought to the Dairy analytical laboratory of the Department of Animal Products Technology, Faculty of Animal Husbandry and Veterinary sciences, Sindh Agriculture University Tandojam, and stored at 4-8°C till analysis.

2.2. Detection of Adulteration in Milk

All the market milk samples were screened for the presence of various adulterants through commercially available milk adulteration testing kit and methods reported by Khaskheji (2010) and Tipu (2012).

2.3. Presence of Extraneous Water

The presence of extraneous water in market milk was detected from depression of freezing point through Cryoscope as reported by Association of Official Analytical Chemists (AOAC, 2000). The value of freezing point of market milk greater than the values of freezing point of control was assumed as presence of extraneous water in market.

2.4. Extent of Extraneous Water in Market Milk

Extent of extraneous water in market milk samples was observed from the depression of freezing point (through Cryoscope) and calculated by subtracting the observed freezing point of market milk from that of freezing point of base (control) and thereafter by dividing it with freezing point of base (AOAC, 2000) using following formula.

\[
\%\text{water added} = \frac{\text{Freezing point base} - \text{observed freezing point}}{\text{Freezing point base}} \times 100
\]

2.5. Freezing Point

Freezing point of market milk samples was determined according to the method of AOAC (2000) using Cryoscope. Milk sample was loaded on the Cryoscope. The constant reading appeared on the screen of Cryoscope was noted and recorded as freezing point of milk sample.

3. Statistical Analysis

Computerized statistical package i.e. Student Edition of Statistix (SXW), Version 8.1 (Copyright 2005, Analytical Software, USA) was used under which following statistical tools were applied for data analysis.

- Summary/ Descriptive statistics
- Analysis of variance (ANOVA)
- Least significant difference; LSD (0.05)

4. Results and Discussion

4.1. Detection of Various Adulterants

In the present study it was observed that water was the most common adulterant (77%) found in the majority of milk samples, followed by detergent (30%), cane sugar (28%), rice flour (27%), caustic soda, (22%), sodium chloride (18%), starch (17%), dalda ghee (6%), respectively (Figure-1). The milk supply is reduced in summer due to fall (55%) in milk
production and increase in demand (60%) compared to winter when milk supply is ample. To cope with demand, water is admixed with whole milk to increase the volume of milk during summer season (Butt, 2011 and Afzal et al., 2011). The proportion of samples adulterated with various adulterants varied in different studies. Similar, finding were observed by Barham et al. (2015). They reported that the majority of milk samples collected from Badin were also adulterated with water (76%), followed by detergent (25%), rice flour (22%), caustic soda (18%), sodium chloride (17%) and cane sugar (14%). When water is added in milk, its foamy appearance diminishes, so to give milk a foamy appearance artificially detergents are added in it. 20% detergent was used in pure cow milk to enhance the cosmetic nature of milk (Manish et al., 2000; Walker et al. 2004). Similarly, Lateef et al. (2009) found 93.33, 86.66, 34 and 13% samples positive to cane sugar and starch. It is of interest to note that the middlemen attempt to counter the dilution by adding cane sugar to extend the solids content of the milk or as additives like starch for the purpose of masking the effect of dilution of water and to increase viscosity of milk up to the consumer acceptance level (Afzal et al., 2011; Fakhar et al., 2006; Singhal et al., 1997; Wadekar et al., 2011). In Brazil, salt was added in milk to mask the high water content (Fertig et al., 2004). This unethical activity (adulteration) is usually adopted by the milk traders to prevent the financial losses due to the spoilage of milk during its transportation and sale (Naz, 2000; Yildiz et al., 2012). In Pakistan and China, milk was adulterated with vegetable oil and dalda ghee to increase the fat level. Similarly, caustic soda was frequently used to neutralize the pH and acidity of milk by the milk traders (Gale and Hu, 2007; Tarique 2001).

**Figure 1.** Various adulterants detected in market milk samples collected from vicinity of Thatta district of Sindh, Pakistan.

### 4.2. Extent of Extraneous Water in Market Milk Samples

High extent of extraneous water of was found in milk samples collected from dairy shops (41.41±4.35%) followed by middlemen (40.03±2.62%), milk collectors (34.02±2.62%) processors (21.53±4.13%) and milk producers (12.90±4.35%). Statistical analysis (LSD, 0.05) showed that the extent of extraneous water in milk samples collected from dairy shops, middlemen and milk collectors was significantly (P<0.05) higher than that of samples collected from processor and milk producer, while there was no any significant difference (P>0.05) in the percentage of extraneous water in between processor and milk producer (Figure-2). The results of present study are in agreement with Barham et al. (2014) they also found high percentage of extraneous water in milk sold by dairy shopkeepers, middlemen and milk collectors. Similar findings have been reported by Nida et al. (2013); Bhatt et al. (2008), they reported that the extent of extraneous water was found to be higher in market milk samples as compared to dairy farms and by milk producers. Present findings are in agreement with that of Wadekar and Menkudale (2011), who reported the vendors and dairy shop keeper are highly, adulterated the milk with water to increase their profit.

LSD (0.05) = 9.40
SE± = 4.73

**Figure 2.** Extent of extraneous water in market milk samples collected from different milk intermediaries at the vicinity of Badin district of Sindh, Pakistan

### 4.3. Freezing Point

In the present study the average freezing point of control milk was recorded as -0.540±0.027°C. While the freezing point of milk samples collected from dairy shops, middlemen and milk collectors was noted as 0.316±0.014°C, -0.324±0.0147°C and -0.356±0.0139°C, respectively. While, the freezing point of milk samples collected from processors and milk producers were recorded as -0.423±0.0220°C and -0.471±0.0240°C. Due to the adulteration of water in milk at all milk marketing channels the freezing point of samples was varied from control milk and it goes towards the freezing point of water which is zero. The least significant difference (LSD, 0.05) of mean test revealed non significant difference (P>0.05) among milk samples collected form dairy shops, middlemen and milk collectors, while the freezing point of milk sold at all three milk intermediaries was significantly different (P<0.05) from freezing point of milk samples collected from processors and milk producers (Table-1).
Table 1. Freezing point of samples collected from different milk intermediaries at Thatta district of Sindh, Pakistan

<table>
<thead>
<tr>
<th>Descriptive measures</th>
<th>Freezing point of milk (°C)</th>
<th>Significance</th>
<th>P-value</th>
<th>LSD (0.05) ±SE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Milk Producers</td>
<td>Milk Collectors</td>
<td>Middle men</td>
</tr>
<tr>
<td>Minimum</td>
<td>-0.561</td>
<td>-0.5440</td>
<td>-0.4530</td>
<td>-0.4590</td>
</tr>
<tr>
<td>Maximum</td>
<td>-0.522</td>
<td>-0.2220</td>
<td>-0.2310</td>
<td>-0.2280</td>
</tr>
<tr>
<td>Mean*</td>
<td>-0.540d</td>
<td>-0.4712c</td>
<td>-0.3564a</td>
<td>-0.324b</td>
</tr>
<tr>
<td>SE±</td>
<td>0.0002</td>
<td>0.0240</td>
<td>0.0139</td>
<td>0.0147</td>
</tr>
</tbody>
</table>

*Means with different letters in same row varied significantly from one another.

4.4. Market Milk Samples (%) Varied in Freezing Point from Control Milk

Moreover, the results presented in Figure 3 showed that 100% milk samples of dairy shops, middlemen, milk collectors 60% of processors and 25% of milk samples collected from milk producers did not show similarity with freezing point of control milk (-0.522 to 0.561°C) and assumed to be positive, adulterated with extraneous water, while 75, and 40% samples were in range of freezing point of control milk samples and assumed to be negative. These results are in line with the findings of Barham et al. (2014). They reported that the freezing point of majority of milk samples collected from dairy shops, middlemen and milk collectors was elevated due to addition of extraneous water as compared to samples collected from processors and milk producers. Milk containing extraneous water will have a grossly elevated freezing point, the extent of extraneous water was found to be higher in market milk samples as compared to samples collected from rural areas. For the fulfillment of the gap between demand and supply different milk marketing dealers adulterate the milk by adding water which is probably carried out during the handling of milk starting from milking till it reaches the consumer or end user (Bhatt et al., 2008; Meredith et al., 2007; Nida et al. 2013; Zia, 2006).

4.5. Extent of Milk Adulteration at Different Milk Intermediaries

The extent of milk adulteration at dairy shops was recorded as 3.75% which was relatively higher than that of middlemen (2.85%), milk collectors (2.20%) processors (1.90%) and milk producers (0.55%), respectively. However, the statistical analysis (ANOVA) showed that the extent of milk adulteration at dairy shops, middlemen, milk collectors and processors was not significantly (P>0.05) different from each other, while it was significantly higher (P<0.05) than that of milk producers (Figure-4). These results are comparatively similar with the results of Barham et al. (2015) they reported that the proportion of milk adulteration at dairy shops was calculated as 3.0±181.29% which was relatively higher than other milk marketing channels, followed by middlemen (2.85±284.28 %), milk collectors (1.85±180.10%) processors (1.10±246.32%) and milk producers (0.40±248.68%), respectively. The rate of adulteration was remarkably high in market milk samples collected from different milk vendors as compared to samples collected from dairy farms (Zia, 2007).

5. Conclusion

On the basis of findings of present study it was concluded that, on the basis of freezing point temperature of control milk, majority of milk samples collected from dairy shops, middlemen, milk collectors and processors were found to be adulterated with extraneous water. The water was the most common adulterant found in majority of market milk samples collected from vicinity of Thatta district of Sindh, Pakistan. While other adulterants like detergent, cane sugar, rice flour, caustic soda, sodium chloride, starch and dalda ghee were also detected. The extent of extraneous water was found to be
higher in milk samples collected from dairy shops, middlemen and milk collectors than the processor and milk producers, respectively. Furthermore, the extent of milk adulteration was also recorded remarkably higher at dairy shops, middlemen, milk collectors and processors as compared to milk producers.

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