Assessment of milk adulteration in the commercially available milk for the consumers in Cauvery delta region of Tamil Nadu, India

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Abstract: Milk, has not been an exception for the pull strings of millennium developments. In recent years, milk available to the consumer is deviated from its inherent nutritional composition because of rampant adulteration. This study was designed to assess the quality with regards to adulteration in milk which is supplied to consumers in and around the Cauvery delta regions of Tamil Nadu. A total of 75 milk samples were randomly collected from various sources like street vendors, tea shops, restaurants, hotels and commercially available pasteurized milk outlets and tested for the presence of common adulterants like starch, sugar, glucose, detergents, neutralizers, salt and skim milk powder. This study revealed that the presence of detergent (48%), sodium chloride (36%), skim milk powder (29.3%), neutralizer (18%), sugar (12%), starch (8%) and urea (8%). It was found that tea shops happened to be a major source followed by restaurant and hotels. It is concluded that awareness needs to be created among the public about the health hazards of adulterants.

Keywords: Adulterants, Cauvery delta region, Milk, Quality assessment

Introduction

Milk is an essential and confirmed source of nutrition (Medhammer et al. 2011; FAO, 2013). Advances in science and technology pillared milk economy with credible preservation and processing techniques which enhanced the availability of milk in remote places which in turn increased the demand for milk in India, even though India ranks first in milk production (Longvah et al. 2013). The inability of the farmers to meet this high demand as well as expectation of more profit out of this high demand paved way for adulteration (Spink and Moyer, 2011). Of all the food ingredients, milk happens to be the second top most food subjected to adulteration (USPC, 2015). Adulteration of milk has become rampant, in entire chain from the level of farmer, middle man, processor and vendor. As per the survey conducted by FSSAI, 20% of milk sold in Tamil Nadu does not meet the standards (FSSAI, 2012). As part of Veterinary Public Health mandate, this study was conducted to assess the quality of milk for its adulteration in the Cauvery delta region of Tamil Nadu.

Materials and Methods

Study area

Three districts viz, Thanjavur, Thiruvarur and Nagappattinam in the Cauvery delta region (CDR) were selected for this study. Before framing the sample collection process, complete analysis about the flow of fluid milk in the CDR was made. (Fig. 1). The debasing activity can be done at any point in the flow of fluid milk from production to consumption. Whatever may be the point of adulteration, samples from street vendors, local tea shops, restaurant and commercial milk outlets would be the true representative of the status of adulteration.

Sampling of milk

A total of 75 milk samples were randomly collected in the study area from the animal owners, milk vendors, tea shops, hotels, restaurants and commercial milk outlets (Table 1). The samples were collected with much care to maintain their original quality. Boiled milk samples from tea shops, hotels and restaurants were collected without sugar. Local tea shops near bus terminals in
district headquarters, town and village panchayat were given preference in the sampling of milk.

**Detection of adulterants in milk**

Milk adulteration kit (K088A HIMEDIA) was used for detection of adulterants such as starch, urea, neutralizer, detergent, sodium chloride, skim milk powder and sugar as per the manufacturer’s instructions.

**Results and Discussion**

The fraudulent, intentional substitution/addition of a substance in a product for the purpose of increasing apparent value of the product/reducing the cost of its production is termed as adulteration (FDA, 2009). Adulterants were discussed under three separate headings. Table 2 shows milk (samples) available to the consumers in the delta region was highly contaminated with detergent. 48% of milk samples tested was found to be contaminated with detergents. Various levels of detergent adulteration in milk were reported by many authors. Sanjita et al. (2017) reported 8.1% detergent adulteration in Rajasthan, 8.4% across India (FSSAI, 2012), 32% in Badin (Soomro et al. 2014) and 44% in Hyderabad (Singuluri and Sukumaran, 2015) and 100% in Dehradun (Kandpal et al. 2012).

ICMR reported that consumption of milk adulterated with detergents cause food poisoning and gastro-intestinal complications (ICMR, 1993). FSSAI notes that consumption of milk with detergents is hazardous to health.

Bhatt et al. 2009 reported that the wide spread availability of synthetic milk in Utter Pradesh was the cause for the prevalence of headache, retarded eyesight and diarrhea among young children.

Detergent adulteration may either be intentional or unintentional. Detergent is a common ingredient in synthetic milk to emulsify and dissolve the oil in water to give frothy nature and characteristic white colour of milk (Kandpal et al. 2012). Also used to give intense frothiness in tea or coffee made with skim milk which gives little or no frothiness. Unintentionally, detergents used for cleaning remains in the vessel due to improper washing (more common in Tea shop) due to lack of awareness on importance of proper washing and the ill effects of detergents on health.

Samples from hotels, shops and restaurant were ordered in glass/silver containers so as to avoid plastic cup (to minimize the cross reaction of plastic with hot milk which may interfere in results). Of the found positive (48%) the order of contamination of

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**Fig 1.** Flow chart depicting flow of fluid milk from production place to consumers
detergents was found to be 83.3% from restaurant, 75.86% from tea shops 66.66% from hotels. Whereas the presence of detergent among loose milk sold in streets and packet milk were low 18.18% and 8.3%.

Neutralizers are added to prevent early spoilage thereby extending the shelf life of milk without refrigeration (Handford et al. 2016) and to mask improper refrigeration due to lack of cold chain (Singuluri and Sukumaran, 2014). In many regions of India milk has been reported to be adulterated with caustic soda, sodium carbonate and sodium bicarbonate to neutralize the developed acidity due to bacterial activity by milk traders. Unhygienic containers, improper transport temperatures also reasons for bacterial growth which cause early raise in acidity. Milk having greater acidity will be positive for clot on boiling test and will be rejected by consumers and also in milk processing plant. To avoid this loss and to mask the acidity, neutralizers are deliberately added to milk (Beall and Scofield, 1995). Some of the deleterious effects of neutralizers are disruption of hormone signal that regulates development and reproduction, Vomition, burn on lips, tongue and sloughing of esophagus mucosa (Mordjikian, 2001; Ryan et al. 2006).

Urea was detected in 8% of the samples analysed. (Table 2). Urea is added for increasing profit out of high demand for milk by increasing protein content and it is the major ingredient of synthetic milk (Mudgil and Barak, 2013). Indiscriminate use of urea containing fertilizer / herbicide / pesticide is also a possible reason of urea in milk (Kandpal et al. 2012). It affects infants and young children especially girls as it hastens up the puberty (Trivedi et al. 2009). Elevated urea levels may be associated with urinary obstruction, Gastro – intestinal disorder and renal diseases (EPA, 2011)

Next most common adulterant found was Sodium Chloride (36%) (Table 3). Whereas prevalence of 54% and 82% sodium chloride among the milk sample in Andhra Pradesh and Hyderabad has already been reported (Ramya et al. 2015). An expected reason behind the addition of NaCl would be to adjust the SNF content after the dilution with water, NaCl significantly elevate the Freezing Point Depression (FDP) hence masking the measurement of extraneous water (Harding, 1995). Samples collected from street vendors were found to have greater level of NaCl followed by restaurant, tea shops, packet milk and hotels. Though NaCl

Table 1 Number of milk samples collected and their source

<table>
<thead>
<tr>
<th>Source of milk samples</th>
<th>Thanjavur</th>
<th>Thiruvur</th>
<th>Nagapattinam</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street vendor</td>
<td>12</td>
<td>5</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>Restaurants</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Tea shops</td>
<td>15</td>
<td>8</td>
<td>6</td>
<td>29</td>
</tr>
<tr>
<td>Hotels</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Commercial milk outlets</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>21</td>
<td>19</td>
<td>75</td>
</tr>
</tbody>
</table>

Table 2 Percentage of adulteration with chemicals

<table>
<thead>
<tr>
<th>Category</th>
<th>Adulterant</th>
<th>Source of samples</th>
<th>No. of Positive</th>
<th>% of adulteration</th>
<th>Overall %</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Detergent</td>
<td>Tea shops</td>
<td>22</td>
<td>75.86</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hotels</td>
<td>4</td>
<td>66.66</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Street vendors</td>
<td>4</td>
<td>18.18</td>
<td>48%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Restaurants</td>
<td>5</td>
<td>83.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial milk outlets</td>
<td>1</td>
<td>8.3</td>
<td></td>
</tr>
<tr>
<td>Neutralizer</td>
<td>Tea shops</td>
<td>7</td>
<td>24.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hotels</td>
<td>1</td>
<td>16.66</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Street vendors</td>
<td>2</td>
<td>9.09</td>
<td>18.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Restaurants</td>
<td>1</td>
<td>16.66</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial milk outlets</td>
<td>3</td>
<td>25.00</td>
<td></td>
</tr>
<tr>
<td>Urea</td>
<td>Tea shops</td>
<td>4</td>
<td>13.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hotels</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Street vendors</td>
<td>1</td>
<td>4.54</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Restaurants</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Commercial milk outlets</td>
<td>1</td>
<td>8.33</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
doesn’t have any health implication, it would be deleterious to people who are hypertensive.

In Table 4, 29.3% samples were adulterated with skim milk powder. Skim milk is a product prepared from milk after removing the essential nutrient components. Even though SMP have milk base, addition of SMP to pure milk reduces the nutritional content of the milk. More recent national snapshot survey on milk adulteration by FSSAI reported 44.7% of milk samples in India are adulterated with SMP (FSSAI, 2012) 80% adulteration of SMP was reported by other authors (Singuluri and Sukumaran, 2014). Apart from this SMP has also gained much popularity among teashop, hotel and restaurant owners to give the desirable thickness in the coffee/tea prepared with diluted milk.

Table 4 shows Starch is another common carbohydrate adulterant that has been reported in milk samples from different places. In this survey only 8% of samples were found to be adulterated with starch. Swathi and Kauser (2015) reported 60% of milk samples from Hyderabad city were adulterated with Starch.

Conclusions

The study evident that practice of milk adulteration is prevalent in cauvery delta region of Tamilnadu with substances that either reduce the nutritional value or it may have toxic effect on consumer. Detergent, Sodium chloride, Neutralizer and Skim milk powder were found to be in the top. Intentional and unintentional sources of detergent in milk must be studied in detail to control its adulteration. Neutralizers are added to mask early stage spoilage of milk which is either poorly stored or unhygienically handled or adulterated with poor quality adulterants. Providing training on hygienic milk production strategies among producers and vendors with necessary chilling facilities will definitely reduce the adulteration with harmful substance like detergents, neutralizers.. Empowering farmers with techniques and skills to face the increasing demand for milk in right way will sound good results. To curb the menace of milk adulteration, stringent legal protection and consumer awareness on the safety and quality must be promoted by administrators.

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