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# Study on food adulteration and buying practices among households in an urban slum of Tamil Nadu

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## Abstract

**Background:** Food adulteration remains a major public health concern, particularly in low socioeconomic settings where awareness and regulatory oversight may be limited.

**Objective:** To assess the awareness and household practices related to food adulteration and to evaluate the presence of adulterants in commonly consumed food items among housewives residing in an urban slum community.

**Methods:** A cross-sectional study was conducted among 250 housewives. Information on awareness and purchasing practices related to food items was collected using a structured questionnaire. Food samples commonly used in households, including Toor dal, tea, chilli powder, turmeric, salt, and milk, were collected and tested using standard qualitative methods for common adulterants.

**Results:** Most respondents were female with lower educational and socioeconomic status. Awareness of food adulteration was limited, with only 48.4% of respondents reporting prior knowledge. Packaged food items were preferred by 55 percent, and 70 percent preferred branded products. Laboratory testing detected iodine deficiency in 37 percent of salt samples. Adulteration was also identified in tea powder (6.3 percent), chilli powder (4 percent), turmeric powder (3.1 percent), milk samples for starch (3.4 percent) and urea (1.1 percent), and Toor dal for metanil yellow (2 percent).

**Conclusion:** Awareness of food adulteration was low among participants, and a high proportion of salt samples were found to be iodine-deficient. Strengthening consumer awareness, increasing community-level screening, and ensuring strict enforcement of food safety regulations are essential to protect vulnerable populations. Promoting simple household food testing methods may support early detection and encourage safer purchasing practices.

**Keywords:** food adulteration, urban slum, iodine deficiency, consumer awareness, food safety, household practices

## Introduction

Food is essential for all living organisms, and its quality plays a crucial role in maintaining health. Food adulteration refers to the deliberate or unintentional alteration of food quality by adding, removing, or substituting substances to increase profit or due to negligence during food handling. It affects properties such as colour, taste, appearance, weight, volume, and shelf life. In India, food adulteration may be intentional or unintentional, and occurs when food fails to meet established standards, compromising its quality and safety [1]. Adulteration may stem from economic motives or poor handling and storage practices.

Food adulteration is highly prevalent in both rural and urban slum settings, largely due to low awareness and inadequate regulatory enforcement. Common examples include adulteration of milk with water, starch, and detergents; wheat flour with chalk powder; and spices such as chilli and turmeric with brick powder

and lead chromate. Tea leaves may be mixed with iron filings, while fruits and vegetables are treated with chemicals like calcium carbide and malachite green to enhance ripening and color. Pulses are sometimes mixed with Kesari dal, and mustard seeds with argemone seeds, leading to severe health issues. Edible oils may also contain toxic adulterants, posing major health hazards in these vulnerable populations [2-6]. Consumption of adulterated food results in serious health consequences, ranging from gastrointestinal disturbances to neurological disorders and cancers. The contamination of mustard oil with argemone oil has resulted in epidemic dropsy and multiple deaths in India [8]. Synthetic chemical dyes and preservatives used as adulterants are known carcinogens, emphasizing the need for stringent monitoring and public awareness [9]. Consumers, particularly from low socioeconomic backgrounds, bear significant health and financial burdens due to adulterated food, making this issue a major public health and economic concern.

Food adulteration is a global problem, with the World Health Organization reporting that approximately 22 percent of food products worldwide are compromised. In India, the Food Safety and Standards Authority of India (FSSAI) analysed 177,511 food samples in 2022-23 and found 44,626 non-compliant samples [7]. Recent international recalls of Indian spices due to carcinogenic ethylene oxide contamination highlight ongoing food safety challenges. Urban slum residents are especially vulnerable to adulterated food due to poverty, limited education, and restricted access to safe and packaged food [10]. They often rely on loose, unpackaged items sold by informal vendors, which increases their exposure to adulteration [11]. Lack of awareness and limited means to detect adulteration further elevate their risk [12]. Consumer behaviour also influences exposure, as many low-income households do not check quality labels such as AGMARK or ISI, expiry dates, or packaging integrity [7,13]. Insufficient knowledge about the Food Safety and Standards Act (FSSA) further contributes to poor consumer vigilance [7,14].

Awareness regarding food adulteration and simple household detection methods remains low among the general population, particularly in slum communities [15]. Individuals with higher education are more likely to read labels, examine packaging, and avoid food of questionable quality, while residents of slums often overlook such precautions due to limited awareness [16]. Despite food safety regulations, only 13 percent of adulteration cases result in convictions, reflecting major enforcement challenges. Lack of reliable data, underreporting, and insufficient public knowledge further complicate surveillance and control efforts [15,16]. In this context, the present study aims to assess the extent of food adulteration, examine purchasing behaviour among homemakers, and evaluate awareness regarding food adulteration and its associated sociodemographic factors in urban slums of Tamil Nadu.

## Materials & Methods

### Study Design

This community-based cross-sectional study was conducted to assess the awareness and practices related to the prevention of food adulteration among homemakers residing in an urban slum.

### Study Setting and Duration

The study was carried out in Preambular, an urban slum situated approximately 1 km from the Urban Health Training Centre of Dhanalakshmi Srinivasan Medical College and Hospital, Preambular, which serves as the field practice area of the Department of Community Medicine.

### Study Population

The study population comprised homemakers residing in the selected urban slum who were available during the study period and provided written informed consent to participate. Eligible participants were selected through systematic random sampling from the sampling frame prepared for the study.

**Sample Size**

A total of 250 homemakers were included in the study. The sample size was calculated using the formula $4pq/l^2$, based on a previously reported prevalence of 76% awareness regarding food adulteration, with 20% relative precision and an additional 10% allowance for non-response.

**Inclusion Criteria**

Homemakers residing in the selected study area who were willing to participate and provided written informed consent were included in the study.

**Exclusion Criteria**

Households that were locked during the survey visit, those without an eligible homemaker respondent, and individuals unwilling to participate or provide informed consent were excluded from the study.

**Data Collection Tool**

Following approval from the Institutional Ethics Committee, a sampling frame of 250 households was prepared with the assistance of a local social worker. Systematic random sampling was employed by selecting every twentieth household. If a selected household was locked or did not have an eligible respondent, the next eligible household was included. After obtaining written informed consent, data were collected using a pre-tested structured questionnaire that gathered information on sociodemographic characteristics, awareness regarding food adulteration, knowledge of common adulterants, methods of identifying adulterated foods, and food purchasing and storage practices. In addition to the questionnaire survey, small quantities of commonly consumed food items, including milk, toor dal, tea powder, chilli powder, turmeric powder, and salt, were collected from each household depending on availability and participant willingness. The samples were transported under appropriate conditions in sterile containers to the Public Health Laboratory of the Department of Community Medicine, where they were analyzed using a standard food adulteration detection kit by trained postgraduate students under faculty supervision. Laboratory findings were documented systematically, and the test results were communicated individually to each household during a subsequent field visit. Participants were also provided with health education regarding the identification, prevention, and health hazards associated with food adulteration.

**Ethical Considerations**

The study protocol was approved by the Institutional Ethics Committee before commencement of the study. Written informed consent was obtained from all participants after explaining the objectives and procedures of the study in the local language. Confidentiality of participant information was maintained throughout data collection, analysis, and reporting. Participation was entirely voluntary, and all study procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki and the Indian Council of Medical Research (ICMR) guidelines.

**Statistical Analysis**

Data were entered into Microsoft Excel and analyzed using SPSS software version 21.0. Descriptive statistics were used to summarize the study variables, with categorical data presented as frequencies and percentages. Associations between awareness of food adulteration and selected sociodemographic variables were assessed using the Chi-square test. A p-value less than 0.05 was considered statistically significant.

## Results

**Table 1: Sociodemographic Details (n=250)**

| Variable | Frequency (n) | Percent (%) |
|---|---|---|
| **Age** | Mean = 36.67; SD = 12.75 | |
| **Gender** | | |
| Female | 250 | 100 |
| **Education** | | |
| Illiterate (24.3%) | 61 | 24.4 |
| Primary (26.1%) | 65 | 26.0 |
| Higher secondary (38.9%) | 97 | 38.8 |
| Graduate (10.7%) | 27 | 10.8 |
| **Occupation** | | |
| Unemployed (52.9%) | 132 | 52.8 |
| Employed (25.7%) | 64 | 25.6 |
| Unskilled worker (21.3%) | 53 | 21.2 |
| **Poverty line status** | | |
| APL (40.4%) | 101 | 40.4 |
| BPL (59.6%) | 149 | 59.6 |

The study included 250 female homemakers with a mean age of 36.67 years (SD 12.75). Nearly one fourth of the participants were illiterate (24.4 percent), while 26 percent had primary education, 38.8 percent had completed higher secondary education, and 10.8 percent were graduates. More than half of the women were unemployed (52.8 percent), followed by 25.6 percent who were employed and 21.2 percent working as unskilled laborers. Regarding socioeconomic status, 59.6 percent of the participants belonged to the below poverty line (BPL) category, whereas 40.4 percent were above the poverty line (APL). All respondents were female homemakers residing in the urban slum area.

**Table 2: Buying practices of housewives on food items (n=250)**

| | Percent |
|---|---|
| **Type of packaging** | |
| Packed | 55% |
| Loose | 25% |
| Both | 20% |
| **Frequency of purchase** | |
| Daily | 4% |
| Weekly | 16% |
| Monthly | 50.0% |
| Based on need | 30% |
| **Preference to branded products** | |
| Yes | 70% |
| No | 30% |

Among the 250 participants, more than half (55 percent) preferred purchasing packaged food items, while 25 percent purchased loose items and 20 percent used both. Regarding the frequency of purchase, half of the respondents (50 percent) bought food items every month, followed by 30 percent who purchased based on need, 16 percent who purchased weekly, and only 4 percent who purchased food items daily. A majority of the homemakers (70 percent) reported preferring branded products, whereas 30 percent did not prioritize branded items during food purchases.

**Table 3: Awareness of food adulteration (n=250)**

| Variable | Response | Frequency (n) | Percent (%) |
|---|---|---|---|
| Heard of food adulteration | Yes | 121 | 48.4 |
| | No | 129 | 51.6 |
| Encountered food adulteration in the past month | Yes | 22 | 8.8 |
| | No | 228 | 91.2 |

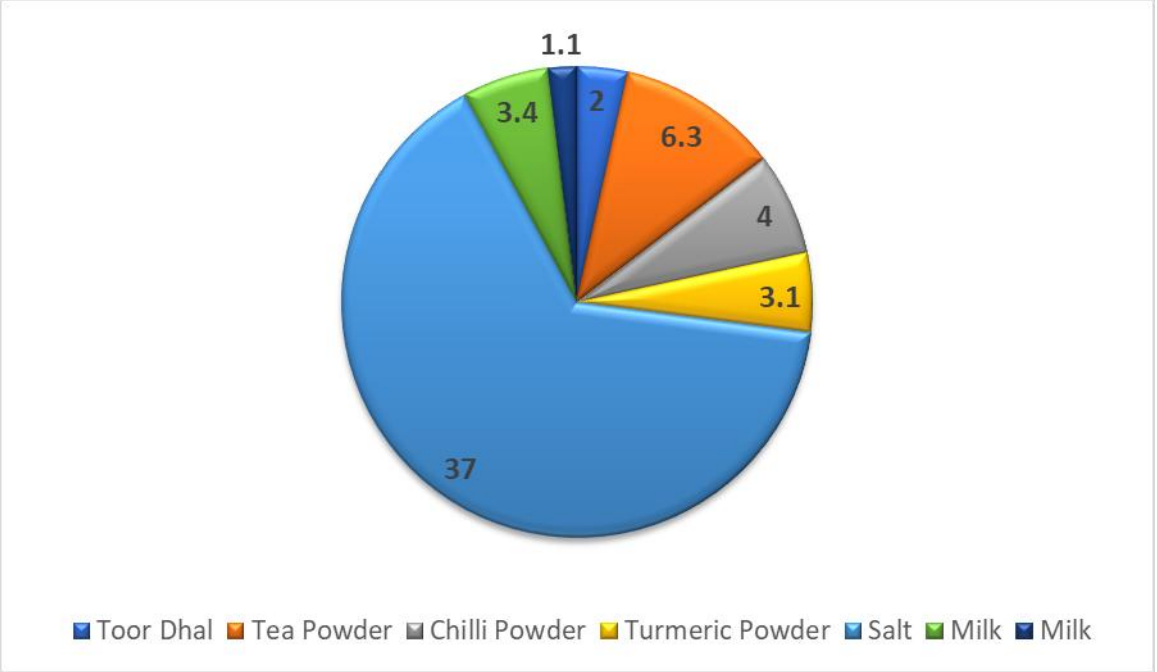
In this study, less than half of the participants had prior awareness of food adulteration, with only 48.4 percent reporting that they had heard about food adulteration, while 51.6 percent did not know of it. When asked about their personal experience with food adulteration in the preceding month, only 8.8 percent reported encountering adulterated food items, whereas the vast majority (91.2 percent) did not report any such experience. This indicates a substantial gap in awareness and perceived exposure to food adulteration among homemakers in the study population.

**Table 4: Adulteration in food products tested by the standard lab testing kit**

| Food Item | Adulterant | Total of collected samples | Total Tested | % Adulterated |
|---|---|---|---|---|
| Toor Dhal | Metanil Yellow | 250 | 234 | 2.0 |
| Tea Powder | Artificial colour | 250 | 203 | 6.3 |
| Chilli Powder | Unknown | 250 | 205 | 4.0 |
| Turmeric Powder | Unknown | 250 | 237 | 3.1 |
| Salt | Iodine Deficient | 250 | 244 | 37.0 |
| Milk | Starch | 250 | 80 | 3.4 |
| Milk | Urea | 250 | 80 | 1.1 |

In the present study, six commonly used household food items were tested for adulteration. Among the 250 samples collected, the highest proportion of adulteration was observed in salt, with 37 percent of samples found to be iodine-deficient. Tea powder showed adulteration in 6.3 percent of the samples due to artificial colouring agents, followed by chilli powder and turmeric powder with 4 percent and 3.1 percent adulteration, respectively. Toor dal exhibited metanil yellow contamination in 2 percent of samples. Milk samples demonstrated adulteration in the form of starch in 3.4 percent and urea in 1.1 percent of the 80 milk samples tested. These findings highlight significant adulteration in essential food items, particularly salt, emphasizing the public health need for awareness, routine surveillance, and preventive strategies in the community.

**Figure 1: Percentage of Adulteration**




## Discussion

There is a lack of awareness about food adulteration among households in the urban slums of Tamil Nadu. The present study revealed that participants had encountered food adulteration, and laboratory testing confirmed adulteration in commonly consumed food items. The most concerning finding was that 37.0% of salt samples lacked adequate iodine, a deficiency linked to goitre and developmental disorders. This closely mirrors findings by Tiwari et al. [21], who reported 35.8% non-iodized salt in Madhya Pradesh, indicating persistent gaps in universal salt iodization. Abidfaheem et al. [22] also identified 10.7% salt adulteration with insoluble impurities in Karnataka. Among spices, tea powder showed the highest adulteration (6.3%), followed by chilli powder (4.0%) and turmeric powder (3.1%). These products are often adulterated with dyes or fillers that pose health risks. Similar adulteration patterns were reported by Patil et al. [23] and Khapre et al. [20] in rural Wardha. Toor dhal samples contained metanil yellow in 2.0%, consistent with FSSAI surveillance findings and observations by Thakur et al. [19], who highlighted both the hazards of such dyes and the importance of educational interventions in detection.

In milk, 3.4% tested positive for starch and 1.1% for urea, findings consistent with Gupta et al. [8]. While starch is added to increase thickness, urea mimics protein content and poses serious renal and gastrointestinal risks. The study further revealed that 56.3% of respondents preferred packaged food items, while 15.1% purchased loose items and 28.7% used both, reflecting increasing consumer awareness regarding hygiene, labelling, and quality. Monthly purchasing was most common (50.0%), followed by purchasing as needed (32.7%), weekly (14.0%), and daily (3.3%), suggesting bulk-buying behaviour. Notably, 72.1% favoured branded products, likely due to perceived better quality control. These findings align with Bhatt et al. [7], who linked education with preference for packaged goods, and Verma et al. [24], who reported similar urban consumer trends.

Economic factors also influenced purchasing decisions. Although Gupta et al. [8] reported that lower-income groups often opt for loose items, many below-poverty-line participants in the present study still preferred packaged brands, suggesting a positive shift in food safety awareness. However, consistent with Khapre et al. [20], many homemakers failed to read food labels, highlighting gaps in functional literacy. Overall, these findings reflect growing but incomplete awareness and underscore the need for targeted educational interventions.

Only 48.2% of participants were aware of food adulteration, and just 8.5% had encountered adulterated food at home in the previous month. Awareness was lower among semi-urban and less-educated participants. Similar awareness levels were reported by Ramesh et al. [25] in Karnataka, whereas Sharma et al. [17] observed higher awareness in urban Delhi, attributed to better education and media exposure. Thakur et al. [19] also documented low baseline knowledge among women in Chandigarh, with significant improvement following educational interventions. Abidfaheem et al. [22] reported only 21.3% good knowledge in Udupi, reinforcing education as a key determinant, as supported by Gupta et al. [8] and Bhatt et al. [7]. Food adulteration is more prevalent in urban slums due to poverty, low literacy, and reliance on informal markets. Similar vulnerabilities were reported by Ramesh et al. [25] in Karnataka and Sharma et al. [17] in Delhi slums. Thakur et al. [19] further noted poor awareness in low-socioeconomic communities, although education significantly improved knowledge. Abidfaheem et al. [22] and Gupta et al. [8] confirmed income and education as strong determinants of food safety practices, while Bhatt et al. [7] and Khapre et al. [20] emphasized poor label-reading behaviour and limited awareness of certification marks.

Food adulteration testing plays a vital role in household food safety. FSSAI [26] has promoted simple household-level tests, such as iodine tests for starch in milk and acid tests for metanil yellow in pulses. Thakur et al. [19] demonstrated improved detection skills following community education, while Abidfaheem et al. [22] reported similar improvements. However, Sharma et al. [17] noted low utilization of household testing despite moderate awareness, indicating the need for sustained outreach. India has strong legal frameworks to combat food adulteration. The Prevention of Food Adulteration Act, 1954 [27] laid the foundation, later replaced by the Food Safety and Standards Act, 2006 [28], which established the Food Safety and Standards Authority of India (FSSAI). Despite initiatives such as DART kits and the *Eat Right India* campaign, Gupta et al. [8] and Sharma et al. [17] reported limited consumer awareness regarding food labelling and certification, highlighting the need for stronger education and enforcement.

## Conclusion

This study highlights that the urban slum population, predominantly female, with lower educational levels and limited economic resources, has very limited awareness of food adulteration. Less than half of the participants had heard of food adulteration, and only a small proportion reported encountering it in the past month. Most households preferred packaged and branded food products, purchased either monthly or based on immediate need. Laboratory testing showed relatively low adulteration levels in most food items; however, salt adulteration was a major concern, with 37 percent of samples found to be iodine deficient. Smaller proportions of adulteration were detected in tea, chilli powder, turmeric, milk, and Toor dal. These findings emphasize the need for consumer awareness programs, regular monitoring of food quality, and strict enforcement of food safety regulations. Promoting simple household-level food testing practices may also help protect public health in vulnerable communities.

**Conflict of Interest:** Nil

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