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## A Study on Food Adulteration in India with Special Reference to Tamil Nadu

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### Abstract

Food alteration is a silent threat affecting millions across India, especially in regions where awareness and regulation are minimal. This study aims to investigate the nature and frequency of food alteration cases across various regions, with a special focus on Tamil Nadu. The responses will be analysed using percentage and average methods to identify patterns in awareness levels, types of adulterants encountered, and the frequency of detection. Special attention is given to rural and semi-urban areas where technological awareness is low and detection tools are rarely used. This research also aims to know whether the people in our country from rural to urban areas have awareness about food adulteration and they know how to detect it and also, they know how to make use of emerging technologies. The research introduces emerging technologies such as AI-based food scanners and portable biosensors, which remain largely unknown to small-scale vendors and consumers. This study aims to propose practical, scalable solutions for improving food safety enforcement and public awareness. By highlighting overlooked areas and proposing inclusive solutions, this research aims to strengthen food safety frameworks and protect vulnerable communities.

**Keywords:** Food alteration, Tamil Nadu, rural food safety, biosensors, AI food scanners, vendor awareness, public health, detection technology, regulatory gaps.

### 1. Introduction

Food alteration has quietly become one of the most overlooked threats to public health in India. From street vendors to packaged goods, the integrity of what people consume is often compromised without their knowledge. Tamil Nadu, with its rich food culture and diverse population, faces unique challenges in maintaining food safety. In rural and semi-urban areas, food is frequently sold through informal channels where regulation is minimal or absent. Many vendors operate without proper training or awareness of food standards, unintentionally contributing to the problem.

Consumers, especially in low-income communities, are left vulnerable due to limited education and access to reliable information. The issue is not just about adulteration, it's about trust, survival, and the right to safe nourishment. While urban regions benefit from better enforcement and awareness, rural regions remain neglected even though many times the urban regions are also neglected. This imbalance creates a silent divide in food safety across the state. Addressing this issue requires more than policy, it demands innovation, empathy, and grassroots involvement.

### 2. Statement of the Problem:

Food is a basic necessity, and its safety should never be

compromised. Food alteration is not just a health issue, it is a matter of survival and dignity. Many people unknowingly consume adulterated food due to lack of awareness and access to detection tools. I believe this research can bring attention to those who are often ignored in policy discussions. It allows me to explore innovative technologies that can make a real difference in people's lives. By choosing this topic, I aim to be a voice for the voiceless and contribute to building a safer, healthier society.

### 3. Review of Literature

Ajay Tomar (2025) <sup>[1]</sup>, reported on the extensive food adulteration problem in Telangana, highlighting that over 60 percent of food adulteration cases go unpunished despite widespread contamination. He detailed inspection data showing thousands of food outlets engaged in adulteration but weak enforcement and lenient penalties allow offenders to escape consequences. Tomar emphasized the need for stronger regulatory accountability to protect public health.

Prataprao Jadhav (2025) <sup>[2]</sup> Union Minister of State for Health and Family Welfare, provided official data revealing that approximately 15% of food samples tested in Telangana were adulterated between 2020 and 2025. He highlighted that only about one-third of these cases resulted in penalties, citing

legal and administrative delays obstructing effective deterrence. Jadhav called for improved laboratory capacity and faster judicial processes.

Ma Subramanian (2025) [3] recently addressed the rise of food adulteration cases in Tamil Nadu, especially affecting rural populations. He advocated for the adoption of emerging, easy-to-use detection technologies at the grassroots level, like portable rapid test kits. He also promoted awareness campaigns in schools and communities to educate people about the dangers of adulterated food and how to identify them. His initiatives focus on combining technology with education to empower rural consumers to combat food adulteration effectively

#### 4. Research Gap of the Study

Most existing studies on food adulteration focus on urban areas and large-scale industries. There is very little research on how food alteration affects small vendors and rural consumers in Tamil Nadu. India is witnessing the rise of cutting-edge technologies to detect food adulteration, yet many rural communities remain unaware of these innovations. This study fills that gap by exploring how these technologies can be introduced to underserved areas and how awareness can be built among vendors and consumers who are currently unaware of such tools.

#### 5. Objectives of the Study:

- i). To find out the types and frequency of food alteration cases in Tamil Nadu across different regions and food categories.
- ii). To analyse the trend of food adulteration practices and how they vary between urban and rural settings.
- iii). To examine the level of awareness among small-scale vendors and consumers regarding food safety and detection tools.
- iv). To evaluate the role of emerging technologies in identifying adulterants and their potential for rural deployment.
- v). To suggest practical, scalable solutions for improving food safety enforcement and public awareness in Tamil Nadu.

#### 6. Methodology of the Study

This research adopts both doctrinal and non-doctrinal approaches. Data has been collected from various sources including newspapers, articles, reports, journals, and electronic resources. The statistical tool employed is the presentation average method. The sample size of respondents is 50, and the duration of the research is five months. The study focuses on food-related cases in India, with special reference to Tamil Nadu.

#### 7. Significance of the Study

This research will help me understand the intersection of public health, technology, and social responsibility. It will improve my analytical and research skills and give me a deeper insight into real-world problems affecting my community. It also allows me to explore new technologies and their practical applications.

If shared with government bodies and food safety authorities, this study can help identify high-risk zones and improve policy enforcement. It can guide the implementation of low-cost detection tools in rural areas and support awareness campaigns. Officials can use the findings to train vendors, educate consumers, and strengthen food safety laws.

#### 8. Hypothesis of the Study

**H<sub>1</sub>:** Increasing public awareness, conducting regular food safety checks, can significantly reduce the prevalence of adulterated food in India.

**H<sub>2</sub>:** The rising demand for low-cost food among consumers is a major factor contributing to the increase in food adulteration across India.

#### 9. Limitations of the Study

This study faced several limitations that may affect the depth and reliability of its findings. Conducted over a short time frame, it lacked the ability to analyse seasonal or market-driven trends in food adulteration. The sample size was narrow due to digital and access constraints, limiting broader representation across Tamil Nadu. Data collection via Google Forms introduced reliability concerns, as responses were self-reported and potentially biased. Additionally, the study did not incorporate historical data or laboratory testing, which could have enhanced technical accuracy. District-level gaps and language barriers further impacted the clarity and inclusiveness of the results, especially in rural areas.

#### 10. Result and Discussion

##### Part A: Doctrinal Research

##### 10.1. Introduction:

Food adulteration refers to the deliberate addition or contamination of food substances with inferior or harmful ingredients. This malpractice compromises food safety, endangers public health, and violates consumer rights. In India, food adulteration has been a persistent issue, despite the presence of regulatory frameworks like the Food Safety and Standards Act (FSSA), 2006. Tamil Nadu, a major consumer and producer of food items, has witnessed several notable cases of adulteration, raising concerns about enforcement awareness. In India, numerous laws and regulations exist to protect consumers from food adulteration, including the Food Safety and Standards Act (FSSA) 2006, Food Safety and Standards (Packaging and Labelling) Regulations 2011, the National Food Security Act 2013, and the Consumer Protection Act 2019. These legislations establish stringent standards for food manufacturing, packaging, labelling, and impose penalties for violations to safeguard public health.

##### 10.2. Common Types of Food Adulterant:

##### i). Food Item: Milk

**Common Adulterants:** Water, detergent, urea, starch, skimmed milk powder, synthetic milk, caustic soda, boric acid, formalin.

**Health Issues:** Diluted milk causes nutritional loss; detergent causes digestive problems; urea and caustic soda damage kidneys and liver; synthetic milk and formalin are toxic and carcinogenic; starch and boric acid cause gastrointestinal irritation and toxicity.

##### ii). Food Item: Tea and Coffee

**Common Adulterants:** Same-coloured leaves (non-edible) in tea; tamarind seeds, mustard seeds, chicory in coffee.

**Health Issues:** Adulterated tea causes liver infections; adulterated coffee causes diarrhoea and digestive issues.

##### iii). Food Item: Wheat and Other Food Grains

**Common Adulterants:** Ergot fungus, chalk powder, sand.

**Health Issues:** Ergot is highly poisonous causing severe poisoning and neurological symptoms; chalk and sand cause digestive problems.

**iv). Food Item: Vegetable**

**Common Adulterants:** Malachite green (carcinogenic dye), calcium carbide (artificial ripening agent), oxytocin (hormone), wax coating, copper sulphate.

**Health Issues:** Carcinogenic and mutagenic risks from dyes; hormonal imbalance from oxytocin; respiratory and digestive issues.

**v). Food Item: Sweets**

**Common Adulterants:** Starch, low-quality silver foil containing aluminium, tar dye in sugar.

**Health Issues:** Aluminium causes neurological issues; starch reduces nutritional value; tar dyes are toxic and carcinogenic.

**vi). Food Item: Honey**

**Common Adulterants:** Molasses sugar, sugar syrup, antibiotics.

**Health Issues:** Antibiotics can lead to drug resistance and liver damage; sugar syrups reduce nutritional quality; allergic reactions may occur.

**vii). Food Item: Pulses (Dal)**

**Common Adulterants:** Metanil yellow (toxic dye), stones, chalk powder.

**Health Issues:** Metanil yellow causes neurotoxicity; consumption leads to brain damage risks; stones cause choking hazard and tooth damage.

**viii). Food Item: Spices**

**Common Adulterants:** Lead chromate, brick powder, artificial colours (Sudan red), sawdust in asafoetida, papaya seeds in black pepper.

**Health Issues:** Lead chromate and artificial dyes are carcinogenic; brick powder causes digestive irritation; sawdust and papaya seeds reduce food quality and cause digestive discomfort

**ix). Food Item: Edible Oils and Ghee**

**Common Adulterants:** Argemone oil (toxic), palm oil, vanaspati (hydrogenated fat).

**Health Issues:** Argemone oil causes epidemic dropsy; vanaspati increases risk of heart disease; adulterated oils cause liver damage and allergies.

**10.3. Special Reference to Tamil Nadu:**

Tamil Nadu has shown notable trends in food adulteration cases over the past five years. According to data shared by the Union Minister of State for Health and Family Welfare, Prataprao Jadhav, about 22 percent of food samples tested in Tamil Nadu between 2021 and September 2024 were found to be adulterated. However, the state has made significant progress in recent years, with the failure rate dropping from around 32.8 percentage in 2022-23 to 12.4 percentage in 2024-25 due to improved enforcement, mobile testing labs, and awareness initiatives. This decrease in adulteration percentage reflects stronger food safety measures being implemented by the Tamil Nadu food safety authorities, including more frequent inspections and better consumer education. Despite progress, the number of cases still remains significant, highlighting the continued challenge food adulteration poses in the state.

**10.4. Rising Food Adulteration In Rural And Undeveloped States:**

In India, many rural and underdeveloped states such as Bihar,

Madhya Pradesh, Odisha, and Uttar Pradesh continue to experience rising food adulteration rates, mainly due to limited awareness, poor infrastructure, and enforcement weaknesses. These states report increasing trends annually, while states like Tamil Nadu, Kerala, and Telangana show signs of improvement due to better regulatory frameworks and monitoring. Thus, while Tamil Nadu's trending decline is encouraging, continuous efforts are necessary to further reduce adulteration cases to protect public health effectively. States with large rural populations like Bihar, Madhya Pradesh, Odisha, Uttar Pradesh report rising food adulteration cases, largely due to poor infrastructure and consumer awareness. Tamil Nadu and Kerala have shown improvements due to better regulatory measures, mobile testing labs, and awareness programs. Telangana struggles with penalties and enforcement despite widespread adulteration.

**10.5. Statistical Data**

Past 5 Years in Tamil Nadu, 22% of food samples tested between 2021 and 2024 were found adulterated. Food samples failing quality in southern states: Tamil Nadu (22%), Telangana (15%), Kerala (13%). National data (2018-23): About 10-13% of samples tested non-conforming yearly, with a peak of 44,421 samples failing in 2022-23 from total tested of 1,72,687. Food adulteration criminal cases initiated in Tamil Nadu increased in some years but resolution rates remain low, around 16% in recent years. Tamil Nadu showed improvement recently with failure rates dropping from 32.8 percentage in 2022-23 to 12.4 percentage in 2024-25, indicating enforcement progress. States with Rural and Awareness Challenges States with vast rural population and low awareness include Bihar, Jharkhand, Madhya Pradesh, Odisha, and parts of Uttar Pradesh, where limited infrastructure and consumer knowledge exacerbate adulteration challenges. Remote regions with poor access to food safety testing often see higher incidences of adulteration due to lack of enforcement [4].

Year	No. of samples analyzed	No. of samples non-conforming	No. of civil cases launched	No. of criminal case launched
2020-21	1,07,829	28,347	24,195	3,869
2021-22	1,44,345	32,934	28,906	4,946
2022-23	1,77,511	44,626	38,053	4,817
2023-24	1,70,513	33,808	33,750	4,737

**Source:** Ministry of Health and Family Welfare <https://www.mohfw.gov.in> Measures taken by the government to stop food adulteration

**10.6. Emerging Technologies for Detecting Food Adulteration:**

**Chromatography:** High-Performance Liquid Chromatography (HPLC) and Gas Chromatography (GC) are used to separate and quantify chemical adulterants like synthetic dyes and preservatives with high accuracy, especially in laboratory settings.

**Portable Rapid Test Kits (DART):** Developed by FSSAI, these kits allow simple, on-site testing by consumers and vendors. They use colorimetric changes to reveal common adulterants like starch, detergent, or synthetic milk, empowering rural and small vendors to verify food quality independently.

**Artificial Intelligence and Machine Learning:** AI models trained on large datasets aid in recognizing adulteration patterns through image analysis and chemical data. Coupled

with IoT and blockchain, these technologies promise real-time monitoring and improved traceability in food supply chains.

**Mobile Testing Labs:** Deployed by regulatory bodies, these labs bring advanced testing technologies to remote areas, increasing enforcement reach and public awareness. These technologies collectively help detect adulterants rapidly, increase transparency, and protect consumer health from the risks of adulterated food

**10.7. Relevant Case Law:**

- i). **Godawat Pan Masala Products I.P. Ltd. & Ors v. Union of India & Ors:** This case challenged the ban on gutka and pan masala containing tobacco under state public health laws. The Supreme Court ruled that food safety regulation falls under central legislation, specifically the Prevention of Food Adulteration Act. It held that state-level bans must not conflict with central laws. The judgment clarified the scope of Article 19(1)(g) (freedom to trade) and upheld reasonable restrictions for public health. It also emphasized the need for uniform food safety standards across India. The ruling became a landmark in balancing federal powers and consumer protection in food regulation [5].
- ii). **Pepsi Foods Ltd. & Anr v. Special Judicial Magistrate & Ors:** The Supreme Court ruled that criminal prosecution under food laws must follow proper legal procedure. Pepsi Foods was summoned without sufficient evidence, violating principles of natural justice. The Court emphasized that companies have the right to challenge arbitrary legal actions. It reinforced that food safety enforcement must be balanced with procedural fairness. This case became a landmark for corporate rights in food law enforcement. It also clarified the role of magistrates in issuing summons. The judgment protected businesses from misuse of criminal law. It highlighted the need for evidence-based prosecution. The case set a precedent for future food safety litigation [6].
- iii). **Nestle India Ltd. v. Food Safety and Standards Authority of India & Ors:** Nestle challenged the nationwide ban on Maggi noodles imposed by FSSAI. The Delhi High Court ruled that the ban was imposed without giving Nestle a fair hearing. The Court ordered fresh testing of samples by accredited labs. It emphasized transparency and scientific accuracy in food safety enforcement. The judgment criticized arbitrary regulatory action. It protected consumer rights while ensuring fair treatment of manufacturers. The case highlighted flaws in sample testing procedures. It led to reforms in how food safety authorities handle large-scale bans. The ruling restored public trust in food regulation. It remains a key case in food law jurisprudence [7].

**Part B: Non Doctrinal Research**

**Table 1:** Do you check food labels and certification before purchasing packaged items?

Indicators	Yes	No	Total
Male	18(36.00)	4(8.00)	22(44.00)
Female	23(46.00)	5(10.00)	28(56.00)
Transgender	0(00.00)	0(00.00)	0(00.00)
Total	41(82.00)	9(18.00)	50(100.00)

Source: Primary Data

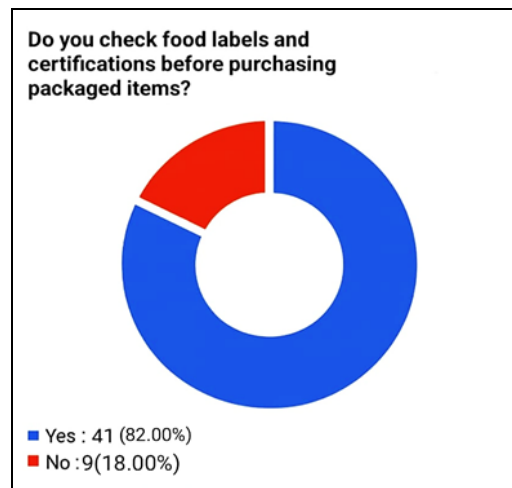


Table No.1 and Pie chart shows that the majority of the responses “Yes” that is 82 percentage surveyed said that they check food labels and certification before purchasing packaged items and the minority of the responses “No” that is 2 percentage surveyed said that they don't check food labels and certification before purchasing packaged items.

**Table 2:** Increasing public awareness, conducting regular food safety checks, can significantly reduce the prevalence of adulterated food in India

Indicators	Strongly Agree	Agree	Neutral	Strongly Disagree	Disagree	Total
Male	8(16.00)	10(20.00)	3(6.00)	0(00.00)	1(2.00)	22(44.00)
Female	7(14.00)	12(40.00)	6(12.00)	0(00.00)	3(6.00)	28(56.00)
Transgender	0(00.00)	0(00.00)	0(00.00)	0(00.00)	0(00.00)	0(00.00)
Total	15(30.00)	22(44.00)	9(18.00)	0(00.00)	4(8.00)	50(100)

Source: Primary Data

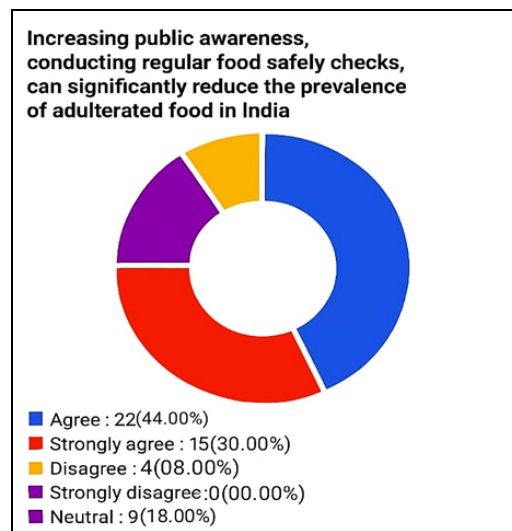


Table No.2 and pie chart shows that majority of the respondent that is 44 percentage agree that Increasing public awareness, conducting regular food safety checks, can significantly reduce the prevalence of adulterated food in India,30 percentage of respondent strongly agree to the given statement,18 percentage of respondent are neutral and not sure about the given statement and the minority of the respondent that is 8 percentage are disagreeing the statement, while none of the respondent are strongly disagreeing the statement.

**Table 3:** The rising demand for low-cost food among consumers is a major factor contributing to the increase in food adulteration across India.

Indicators	Strongly Agree	Agree	Neutral	Strongly Disagree	Disagree	Total
Male	5(10.00)	10(20.00)	4(8.00)	1(02.00)	2(02.00)	22(44.00)
Female	4(08.00)	20(40.00)	3(03.00)	0(00.00)	1(02.00)	28(56.00)
Transgender	0(00.00)	0(00.00)	0(00.00)	0(00.00)	0(00.00)	0(00.00)
Total	9(18.00)	30(60.00)	7(14.00)	1(02.00)	3(06.00)	50(100)

Source: Primary Data

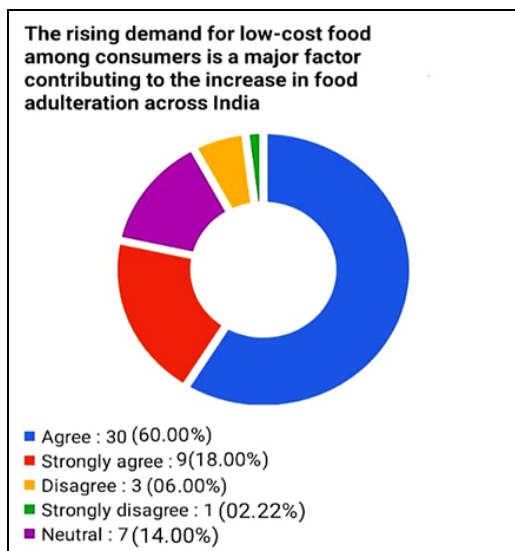


Table No.3 and pie chart shows that majority of the respondent that is 60 percentage agree that The rising demand for low-cost food among consumers is a major factor contributing to the increase in food adulteration across India,18 percentage of respondent strongly agree to the given statement,14 percentage of respondent are neutral and not sure about the given statement and the minority of the respondent that is 6 percentage are disagreeing the statement, and only 2 percentage of the respondent are strongly disagreeing the statement.

**11. Testing of Hypothesis:**

**H<sub>1</sub>:** Increasing public awareness, conducting regular food safety checks, can significantly reduce the prevalence of adulterated food in India

Table No.2 shows that the majority of the respondents that is 44 percentage are agree with the given statement and 30 percentage of the respondents strongly agree with the statement. Therefore the hypothesis is accepted.

**H<sub>2</sub>:** The rising demand for low-cost food among consumers is a major factor contributing to the increase in food adulteration across India.

Table No.3 shows that the majority of the respondents that is 60 percentage are agree with the given statement and 18 percentage of the respondents strongly agree with the statement. Therefore the hypothesis is accepted.

**12. Conclusion**

Food adulteration continues to pose a serious challenge in India. Through this research, it is evident that while the trend of adulteration fluctuates, it has not been eradicated. It is not enough to merely reduce food adulteration, we must aim to eliminate it entirely from our country. This is a collective responsibility that falls on every citizen, industry, and

governing body, because food is a basic necessity, and its quality and safety should never be compromised. The government must strengthen its food safety mechanisms by implementing stricter regulations and conducting regular monitoring and inspections. Industries must uphold ethical standards, and citizens must remain vigilant and informed. Only through unified action can we move toward a future where safe, unadulterated food is not a privilege, but a guaranteed right for all.

**Suggestions:**

- i). Food safety and adulteration awareness should be taught to children in schools and colleges.
- ii). Every Consumers should check the packaged food items carefully before buying.
- iii). Checking labels and expiry dates should become a regular habit when buying goods and also children must be taught to this
- iv). Food adulteration can be detected easily and quickly by emerging technologies and the knowledge to use this technologies should be taught to every consumer especially consumer in rural areas
- v). Organize local workshops or school programs to demonstrate simple detection methods.
- vi). Promote affordable tools like paper strip tests, handheld sensors, or smartphone-based detection apps by partnering with local startups and NGOs to ensure their widespread distribution in rural areas.

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