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Common food adulterants detection

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Abstract
Food adulteration is under looked issue in India. As our consumers are not aware about how degraded product are consuming in daily life which poses major threat to their health. This research proposes the development of: Smart Food Guard, a user-friendly mobile application that serves as a comprehensive digital repository of common food adulterants, their health impacts, and scientifically validated low-cost testing protocols. This mobile app is very user friendly and its main purpose is to educate users about nutrition and how to detect food adulteration. The application integrates a searchable database, visual demonstrations, multi-language support, and geo-tagged reporting features to encourage community-driven vigilance.

Keywords: Food adulteration, degraded product, adulterants, low-cost testing protocols, intentional adulteration, incidental adulteration, metallic adulteration

Introduction

Unfortunately, food adulteration has become major and under addresses issue of Indian food production sector. It refers to the intentional or unintentional addition of inferior or harmful substances to food products, compromising their quality, safety, and nutritional value. Also, adulteration is not limited to food but now we are uncovering adulteration in medicines also. This is leading India to have more unhealthy population. According to reports from the Food Safety and Standards Authority of India [1], over 27% of food samples tested in recent years were found to be adulterated or misbranded. In age of rapid growth of smartphone use we present Smart Food Guard app that provides a searchable database of common food adulterants, their associated health risks, and step-by-step guides for low-cost detection methods using household materials.

Related Work

[2] Three out of four firms convicted of misbranding or selling adulterated food products escape unpunished, health ministry records show, even as Nestle India and the instant-noodle industry continue to endure what now seems to have been an overblown scare over contaminants.

[13] In addition to cheating consumers and being a significant economic issue, food adulteration is a serious health threat for consumers. More than 200 acute and chronic diseases, from cancer to digestive tract infections, are recognized to be triggered by food-borne hazards. Food adulteration thus negatively impacts the quality of life and its regulation requires a robust food-defence strategy that covers the whole food-supply chain. Here's your paragraph with the spacing issues fixed and a few minor grammatical improvements for clarity. Food adulteration is the activity of reducing or degrading the quality of food by either withdrawing some essential components from it or by introducing unsafe or lower-quality material, making it unsuitable for human consumption. The toxic substance introduced is referred to as an adulterant. Adulterants are dangerous in all forms and have the potential to reduce the potency of the food product to which they are added. Even if the adulterant is not immediately harmful, its presence degrades the food's natural quality and significantly lowers its nutritional value. Prolonged exposure to adulterants has been proven to be deadly or carcinogenic. Greed for higher profit margins: It has been observed that certain unscrupulous manufacturers, importers, distributors, and retailers deliberately practice food adulteration as a business strategy to maximize profits with minimal expenditure and by using cheaper means. Expanding financial revenue by increasing volume is one of the primary driving forces behind adulteration. Shortage of manpower and lack of random quality checks: Another important reason for food adulteration is a shortage of trained manpower, outdated food processing methods, and a lack of random quality checks on suspicious goods. Rising food consumption due to a rapidly expanding population: The issue of food adulteration is greatly exacerbated by the expanding population. With the tremendous rise in population and purchasing power, the demand for food supplies is rapidly increasing. To meet this rising demand, adulteration has become a common practice.

[15] Preservatives are added to food products primarily to extend shelf life, prevent microbial growth, and maintain flavor, color, and texture during storage and transportation. According to a study by the Food and Agriculture Organization (FAO, 2015), preservatives like sodium benzoate, sulfur dioxide, and nitrates are commonly used to inhibit the growth of bacteria, molds, and yeasts, thereby ensuring food safety and reducing food waste. However, while preservatives serve important functions, their excessive consumption poses significant health risks. Research published in the International Journal of Pharmaceutical Sciences and Research (IJPSR, 2017) highlights that certain preservatives, such as sodium nitrite, have been linked to an increased risk of cancer, particularly colorectal cancer, due to the formation of carcinogenic nitrosamines. Additionally, sulfite preservatives can trigger allergic reactions, especially in asthmatic individuals (FDA,

2018). Other harmful effects include potential behavioral changes in children (linked to preservatives like sodium benzoate) and an increased risk of hypertension and heart disease from frequent intake of processed foods containing trans fats and nitrates. Thus, while preservatives play a critical role in modern food systems, their use must be carefully regulated to minimize health hazards. Sodium benzoate (E211) occurs in carbonated beverages, pickles, sauces, and some medications. Sulfur dioxide (E220) is found in carbonated beverages, dried fruits, cordials, and potato products. Sodium meta-bisulfite is a preservative and antioxidant, and potassium nitrate (E249) is found in cured meats and canned meat products. P-hydroxy benzoic acid esters (parabens) occur in preserved foods and medicines. Lactic acid bacteria occur in fermented foods. Monosodium glutamate (MSG) is also added to frozen foods, canned tuna, and vegetables to flavor them. Sodium nitrite and sodium nitrate are added in processed meats and fish to preserve red color and avoid botulism. Trans fat occurs in deep-processed fast foods and other processed foods. Sodium sulfite (E221) occurs in wine making and other processed foods. Potassium bromate is added to white bread, rolls, and flour to enhance texture. Finally, propyl gallate and tertiary butyl hydroquinone are added to processed foods, vegetable oils, and meat products to inhibit spoilage.

[14] The Indian food business has grown into a very profitable industry, coming fifth in the world in production, consumption, export, and projected growth. Indian food legislation guarantees that the products are pure, safe, and manufactured in sanitary conditions and does not allow adulteration and false descriptions. Market access requires adherence to local sanitary and phyto-sanitary regulations. To integrate different scattered legislations, the Indian Parliament passed the Food Safety and Standards Act (FSSA), 2006, replacing previous regulations like the Prevention of Food Adulteration Act, 1954; Fruit Products Order, 1955; and others. Previously, food safety legislations at state levels created barriers to trade, necessitating a single central legislation. The Prevention of Food Adulteration Act, 1954, sought to avoid food adulteration through standardized sampling and analysis, penalties, and controls on additives, packaging, and labelling. Because of changing industry requirements and the limitations of the Act, the FSSA, 2006, was enacted to modernize and simplify India's food safety system.

Working Methodology

1. Types of Adulteration

FSSAI recognizes three types of food adulteration: intentional, incidental, and metallic [1]

1.1 Intentional Adulteration

Intentional adulteration is defined as the intentional mixing of poisonous or inferior materials for profit as it reduces the cost of manufacturing. As per the Food Safety and Standards Authority of India [1], these practices are most common in unorganized food industries and small-scale retailers. Adulterants can be physical or biological in nature.
Some typical examples are:
Water, starch, or detergent addition to milk for volume and whitening.
Adding brick dust or salt dust to chili powder to add weight and color.
Lead chromate in turmeric for added color and weight.
Diluting mustard seeds with Argemone seeds, which are poisonous and responsible for epidemics of epidemic dropsy.
Adding starch and synthetic milk into paneer for more and volume.
These adulterants are not only illegal but may be carcinogenic, nephrotoxic, and neurotoxic, presenting severe long-term health consequences. Repeatedly ingesting these toxins can lead to the onset of cancers, kidney problems, and permanent neurological damage to major organs and the body as a whole. Additionally, these harmful chemicals can also build up in the body over time, increasing the risk of serious health complications, including organ failure, children's developmental disorders, and even death in severe cases. Hence, the occurrence of such adulterants in food not only goes against food safety regulations but also poses a threat to public health on an enormous scale.

1.2 Incidental Adulteration

Incidental adulteration results from unintentional contamination through food handling, storage, or processing. This form of adulteration does not result from deliberate acts, unlike intentional adulteration. Instead, this form often stems from substandard food safety practices or insufficient sanitation.

Examples of Incidental Adulteration

Pesticide Residues: Vegetables and fruits are often infested with pesticide residues as a result of excessive or improper use of farm chemicals. A study by the Indian Institute of Toxicology Research (IITR) detected pesticide residues in more than 25% of fruits and vegetables in local markets, and this raised fears of toxic accumulation within human bodies [3].

Insect Contamination: Stored cereals, pulses, and grains are most likely to get infested by insects or rodents, thereby contaminating the food items. A study done by Chaudhary *et al*. (2021) identified that 8% of flour samples contained insect fragments and are likely to cause allergenic reactions and gastrointestinal disorders [4].

Heavy Metal Contamination: Polluted water sources or processing could introduce contaminants like lead, mercury, and arsenic into food products. A study by Patel & Mishra (2022) revealed that arsenic contamination was detected in 22% of rice samples from Indian markets, which could result in cancer, organ failure, and neurological impairment [5].

Health Implications of Incidental contaminants, especially heavy metals and pesticide residues, have long-term effects on health. Prolonged exposure leads to organ damage, cancer, endocrine disruption, and reproductive problems [6].

1.3 Metallic Adulteration

This form of adulteration involves the contamination of food products by metals like lead, cadmium, mercury, and arsenic, usually from contaminated water, soil, or storage containers.

Examples of Metallic Adulteration

Lead Chromate in Turmeric: Lead chromate (a recognized industrial dye) is used to make turmeric look more intense and yellow. Research has identified the toxicity of lead chromate, which leads to lead poisoning, impacting the nervous system, kidneys, and liver [7].

Arsenic in Rice: Arsenic naturally exists in soil and water but builds up its content in rice and other food items due to pesticides and polluted irrigation methods. Researchers found that arsenic at a high concentration (33%) is present in India's rice products, and consumption of this highly toxic arsenic can have grave health effects, including cancer, skin diseases, and lung infection [8].

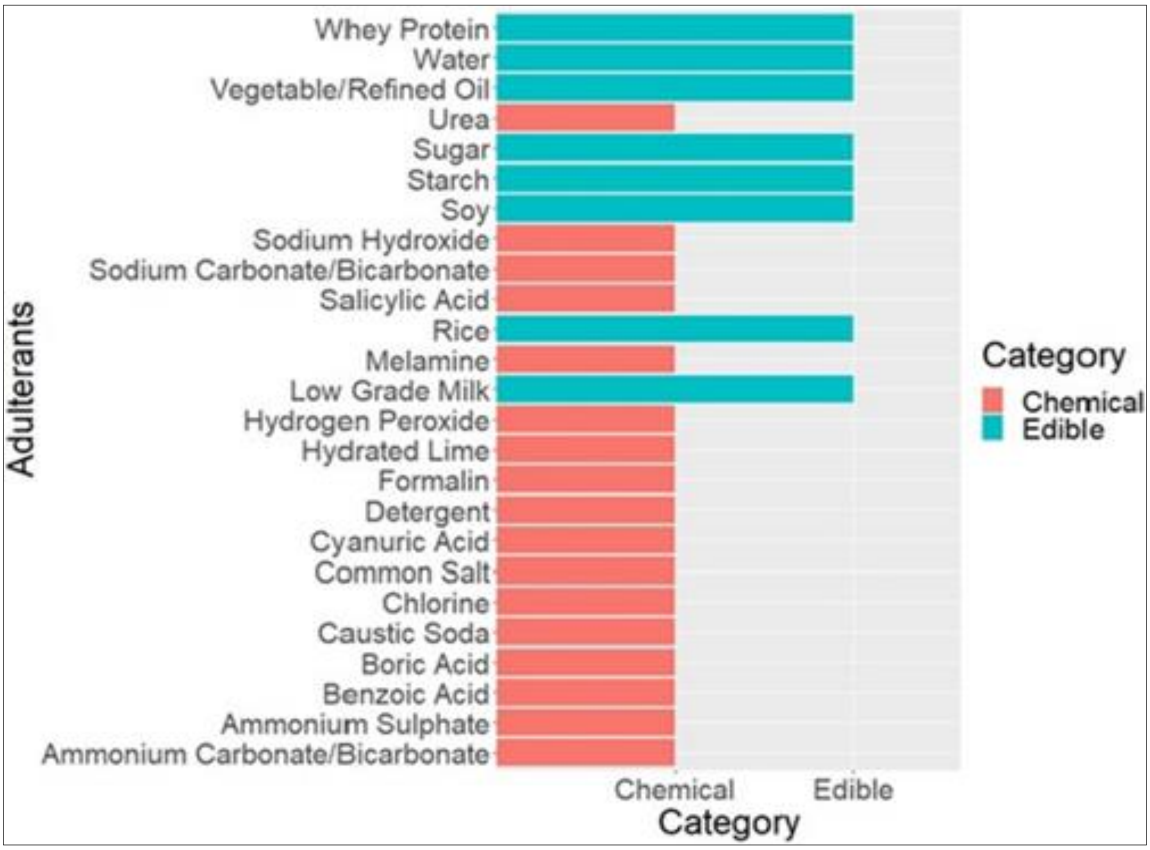
Health Implications of metallic adulteration is heavy metals are harmful even at low levels and have the potential to accumulate in the body over time, causing neurological disorders, renal failure, cancer, and cardiovascular diseases [9].

Food Adulteration in India

For some reason we were not able to gather latest data on Food adulteration as most of studies/research have data based on 2014.

[15] Understanding the Problem: We began by finding out which foods are most frequently adulterated in common homes—such as milk, turmeric, salt, and pulses. Next, we studied how individuals presently identify adulterants, ranging from simple home tests to laboratory techniques. Collecting the Right Data -

Next, we obtained real samples of both pure and adulterated food items. For some, we used publicly available data sets. In others, we did simple chemical tests ourselves—such as adding iodine to check for starch in milk—and noted the results, including photos and colour shifts.



Source: Milk Adulterants in India and their Detection Techniques

Training the App to Recognize Adulteration

We taught the app to "learn" from them through machine learning. If it's an image (such as a picture of turmeric), the app takes visual hints such as color and texture. If it's a test result (such as a color shift in water), the app interprets those patterns as well. The models were made to be lightweight so they'd work fine in smartphones.

Creating the App Itself, so after the detection models were developed, we constructed the mobile app. We made it easy for anyone to use—whether you're a student, parent, or vendor. You can either: Snap a photo of the food item, or input a brief test result (such as "turned blue after adding iodine"). The app will then scan it and inform you if it's probably adulterated or safe.

Making the Results Easy to Understand

Following a scan, the app presents a clear result:

Is adulteration detected?

What type is suspected?

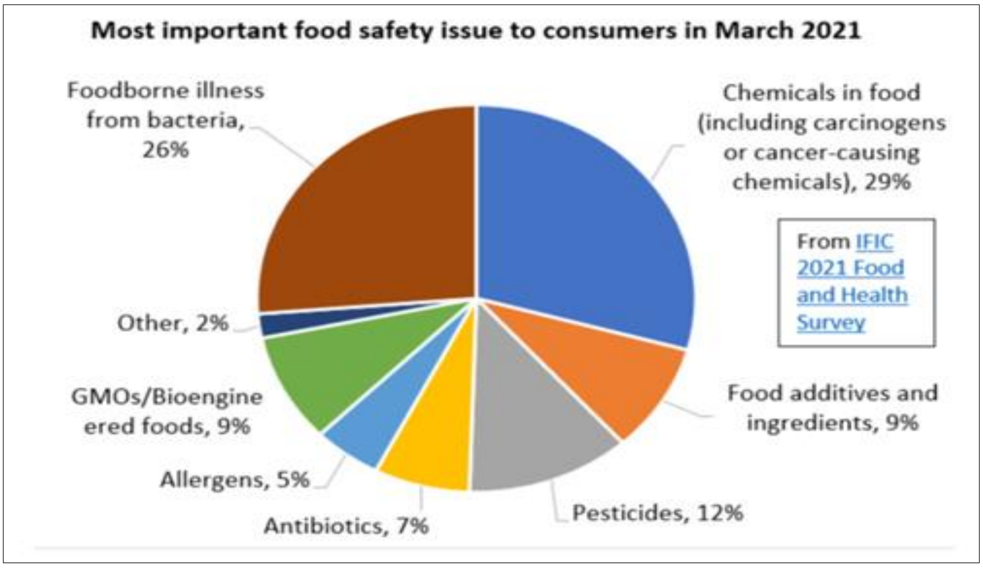
How confident is the app in its judgment?

By doing so, users are able to make decisions based on informed knowledge without having to be a food scientist.

Enforcement Metrics (FSSAI Annual Report**)**

S. No.	Enforcement Metric	2018-19	2019-20
1	Analyzed Food Samples	1,06,459	1,18,775
2	Samples Found Non-Conforming	30,415	29,192
	▪ Unsafe	3,900	4,526
	▪ Sub-Standard	16,870	15,671
	▪ Labeling/Misleading	9,645	8,995

Source: FSSAI Annual Report 2018-19, 2019-20



Source: Food Adulteration: A Global Threat

Future Scope

Conclusion

Food adulteration remains a critical yet often overlooked public health concern in India. With the increasing prevalence of harmful contaminant whether intentional, incidental, or metallic. We need more awareness, accessible detection methods. The *Smart Food Guard* mobile application addresses this need by combining educational resources, practical detection guides, and user-friendly features into a single, accessible platform. By empowering consumers with knowledge and tools to identify adulterants and report them in real-time, this app fosters a culture of food safety, transparency, and accountability. Ultimately, *Smart Food Guard* not only contributes to individual well-being but also strengthens the collective responsibility towards safer food systems. Future enhancements may include integration with official food safety bodies, AI-based image recognition for adulterant detection, and expansion into rural and regional markets, ensuring a more comprehensive and inclusive approach to food safety in India.

Refrences

1. FSSAI. Quick tests for some adulterants in food. Food safety and standards Authority of India, 2012.
2. Patil GS. In India, 3 of 4 companies adulterating, mis-branding food go unpunished.
3. Indian Institute of Toxicology Research (IITR), 2019.
4. Chaudhary *et al*, 2021.
5. Patel *et al*, 2022.
6. Awasthi *et al*, 2021.
7. Rastogi *et al*. 2020.
8. Ghosh S *et al*. Prevalence of *Aflatoxin* contamination in Indian grains and its implications on health. Mycotoxins Journal,2021:27(1):33–45.
9. Gupta P *et al*. Heavy metal contamination in Indian food products: a review of literature. Environmental Research,2019:42(5):555–67.
10. Kumar *et al*. Health impacts of food adulteration in India. International Journal of Food Safety Hygiene, 2022.
11. Kumar R *et al*. Health impacts of food adulteration in India. International Journal of Food Safety Hygiene.2022:9(3):112–18.
12. FSSAI. Pan India survey on food safety, 2019. Available from: www.fssai.gov.in
13. WHO. Food safety fact sheet, 2022. Available from: www.who.int
14. ICMR. Health effects of heavy metal contamination. Indian Council of Medical Research Bulletin, 2021.
15. Journal of Environmental Health Research. Aflatoxin contamination in Indian grains, 2021, 18(4).
16. Sharma R *et al*. Lead chromate contamination in Indian spices: a threat to public health. Journal of Food Safety,2021:34(3):142–50.
17. Awasthi G *et al*. Pesticide residue in Indian fruits vegetables: health risks mitigation strategies. Environmental Toxicology,2021:26(4):112–21.
18. Ghosh S *et al*. Prevalence of *Aflatoxin* contamination in Indian grains and its implications on health. Mycotoxins Journal,2021:27(1):33–45.
19. Gupta P *et al*. Heavy metal contamination in Indian food products: a review of literature. Environmental Research,2019:42(5):555–67.
20. Singh S *et al*, 2020.
21. Naseem N. Food adulteration: a socio-legal problem. 2023.
22. Jyotsna K *et al*. Law student's, Amity Law School. IJCRT, 2021, 9(8).
23. Momtaz M *et al*. Mechanisms and health aspects of food adulteration: a comprehensive review.
24. Patil GS. In India, 3 of 4 companies adulterating, mis-branding food go unpunished.
25. Yadav AK *et al*. Key milk adulterants in India and their detection techniques: a review. Food Analytical Methods,2023:16:499–514.
26. Rudra K. Food adulteration: a global threat.
27. Kumar P *et al*. Digital health monitoring systems for food safety: an emerging need. International Journal of Food Science, 2022.
28. Google-KPMG. Indian languages: defining India's internet, 2017.
29. Statista Research Department. Growth of voice tech in India, 2023.
30. Wang X *et al*. Application of IoT AI in food safety monitoring. Trends in Food Science Technology, 2022.
31. Consumer Physics SCiO Product Page.