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Research Note

Qualitative Analysis of Adulterant Mixed in Different Food Stuffs

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Abstract

This study focuses on identifying adulterants present in items such as food, fuels, chemicals and cosmetics, known for degrading their overall quality. The escalating concern over food adulteration prompted this research, emphasizing the detection of adulterants in daily consumables. The detrimental effects of food adulteration are profound, leading to health issues such as cancers (colon and peptic ulcer diseases), chronic liver diseases, electrolyte imbalance, kidney failure, heart diseases, blood disorders, and bone marrow abnormalities. The primary objective of this research is to ensure the quality of commonly consumed food items by detecting potential adulterants. Numerous rapid detection techniques have been developed to address this problem, including the implementation of quick and straightforward DART methods (Detect Adulterant Rapid Test). In this study, we applied various DART and DIY methods to test selected food items like milk, turmeric powder, and chilli powder. Each sample underwent testing with specific chemical reagents to determine the presence of adulterants. Post-tests, the samples were analyzed for observable changes, and conclusions were drawn regarding the presence or absence of adulterants in each tested item.

Keywords: Adulterants, DART, DIY, Human health

Main Body

Food stands as a fundamental necessity for the sustenance of all living beings, playing a vital role in growth and various life processes (Foskett et al., 2021). The quality of the food we consume is paramount, as subpar products can have detrimental effects on consumer health. Unfortunately, in contemporary times, there is a prevalence of poor-quality food products, exemplified by instances such as the adulteration of milk with water or starch, the inclusion of tiny stones in rice, and the addition of chalk powder to sugar, among other adulterations like metanil yellow in pulses and lead salts in chilli powder (Rees, 2020).

Food adulteration, defined as the introduction of unwanted elements into foodstuffs, is considered a legal offence when the product fails to meet established standards or quality (Rahman et al., 2015). The intentional, unintentional, or naturally occurring adulteration of food presents challenges for consumers in detecting the extent of adulteration. The irresponsible practices of producers and sellers during production or the presence of undesirable substances in raw materials contribute to this problem, persisting across all stages of food from preparation to consumption (Wani et al., 2015).

The consequences of food adulteration extend to health risks, including toxicity, chemical contamination with substances like formalin, mycotoxins, metals, and pesticides in commonly consumed items such as milk and rice, which pose significant threats to human health (Vyralakshmi & Jayasheela, 2017). Moreover, excessive use of colouring dyes, calcium carbide, urea, lead chromate, coal tar, and prohibited colours and preservatives affects multiple organs in the human body (Banti, 2020).

This study aims to raise awareness about food adulteration and its long-term adverse effects on health. Various tests and experiments conducted during this project employ accessible and rapid methods, ensuring that individuals can perform them in their local labs using readily available chemical reagents. The simplicity of these procedures eliminates the need for specialized expertise, allowing ordinary individuals to test their daily foodstuffs and safeguard against the consumption of adulterated food to a significant extent.

Samples were gathered from various vendors in the Rupandehi district, including milk (from local farmers and packed samples), turmeric powder (open and packed samples), mustard oil (open and packed samples), chilli powder (open and packed samples), and open sugar from the local market.

Numerous techniques exist for detecting food adulterants, including chemical tests, DART, DIY, HPLC, GC-MS, and spectroscopic methods. In this study, rapid chemical tests, DART and DIY methods were employed. Starch presence in milk was identified using an iodine solution, with a blue colour indicating its presence. Detection of skim milk powder involved testing with dil. HNO_3 and an orange colour indicated its presence. Detection of lead chromate and coal tar dye in turmeric powder was carried out with conc. HCl, 1% diphenyl carbazide reagent, petroleum ether, and conc. HCl, revealing the presence through colour changes. Detection of argemone oil in mustard oil and red colour lead salt in chilli powder involved conc. HCl and 10% $FeCl_3$, as indicated by colour crystals and layers. Chalk powder and washing soda in sugar were identified using conc. HCl (He et al., 2021; Elmadfa, 2005).

Public concern and reactions significantly influence perspectives on food safety and health (Pal & Mahinder, 2020). Numerous instances of food adulteration have been recorded in products like vegetables, fruits, spices, oils, meat, fish, milk, and drinks (Schieber, 2018). Local findings reveal extensive adulteration, particularly in spices. Turmeric powder, a popular natural colouring, often contains harmful additives like coal tar colour or lead chromate, impacting its brightness (Sudershan et al., 2009). Notably, turmeric powder and mustard oil are highly adulterated, containing harmful substances like coal tar dye and prohibited colours, as indicated in the table below from the conducted tests.

Table 1 reveals the absence of lead chromate in all samples tested, while coal tar dye is present in both packed samples but absent in the open sample from a local farmer. These adulterants pose severe health risks, with lead chromate potentially causing anaemia, brain damage, paralysis, and miscarriage, especially when added to spices for vibrant colouring (Cowell et al., 2017). Coal tar dyes, by-products of hydrocarbon solvents, are considered unsafe for consumption. Heavy metal additions, like aluminium in trace levels, may harm the brain, potentially leading to conditions like Alzheimer's. Lead-contaminated foods, deadly poisonous, adversely affect various body parts, especially in children, causing issues like sleeplessness, irritability, restlessness, and mental retardation (Momtaz et al., 2023). Chilli powder in this study did not exhibit the presence of red-coloured lead salts.

Table 1: Detection of adulterants in different food items.

Adulterant in food	Open sample	Packet sample
Lead chromate in turmeric powder	Absent	Absent
Coal tar dye in turmeric powder	Absent	Present
Lead salts in chilli powder	Absent	Absent
Starch in milk	Absent	Absent
Skim milk in milk	Absent	Present
Argemone oil in mustard oil	Absent	Present
Prohibited oil in mustard oil	Absent	Present
Chalk powder/ washing soda in sugar	Absent	Absent

Food items, such as milk, sugar, and chilli powder, exhibited either minimal or no adulteration in the chosen small and local sample area. However, these findings don't necessarily extend to other regions. The limited sample area influenced the lower extent of observed adulteration. To achieve comprehensive results on food adulteration, a broader sample collection area is essential. Methodology plays a crucial role, and this study employed rapid techniques due to cost and time constraints. While the qualitative approach lacks standardized data for comparison, results may vary based on different brands, manufacturing methods, and regional disparities observed in previous research. Developed countries often show minimal adulteration, contrasting with higher levels in underdeveloped nations like Nepal, attributed to producer greed, fraud, and buyer ignorance.

Detecting sophisticated food adulteration methods demands highly efficient and reliable techniques. The conducted laboratory tests on a limited sample of daily-used food products reveal a concerning trend: while some items are safe, the majority of packed foods consumed are adulterated. The study, based on a restricted sample, concludes that approximately half of these items are adulterated, suggesting a potential rise in adulteration.

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References

Banti, M. (2020). Food adulteration and some methods of detection, review. *International Journal of Nutrition and Food Sciences*, *9*(3), 86-94.

Cowell, W., Ireland, T., Vorhees, D., & Heiger-Bernays, W. (2017). Ground turmeric as a source of lead exposure in the United States. *Public Health Reports*, *132*(3), 289-293.

Rahman, M. A., Sultan, M. Z., Rahman, M. S., & Rashid, M. A. (2015). Food adulteration: A serious public health concern in Bangladesh. *Bangladesh Pharmaceutical Journal*, *18*(1), 1-7.

Elmadfa, I. (Ed.). (2005). *Diet diversification and health promotion* (Vol. 57). Karger Medical and Scientific Publishers.

Foskett, D., Paskins, P., Pennington, A., & Rippington, N. (2021). *The theory of hospitality and catering*. Hachette UK.

Pal, M., & Mahinder, M. (2020). Food adulteration a global public health concern. *Food Nutri*, *1*(3), 38-9.

Momtaz, M., Bubli, S. Y., & Khan, M. S. (2023). Mechanisms and health aspects of food adulteration: A comprehensive review. *Foods*, *12*(1), 199.

Rees, J. (2020). *Food adulteration and food fraud*. Reaktion Books.

Schieber, A. (2018). Introduction to food authentication. In *Modern techniques for food authentication* (pp. 1-21). Academic Press.

Sudershan, R. V., Pratima, R., & Kalpagam, P. (2009). Food safety research in India: a review. *Asian Journal of Food and Agro-Industry*, *2*(3), 412-433.

Vyralakshmi, G., & Jayasheela, G. (2017). Food adulteration and contamination-a catastrophe. *IOSR JESTFT*, *11*(7), 62-70.

He, Y., Bai, X., Xiao, Q., Liu, F., Zhou, L., & Zhang, C. (2021). Detection of adulteration in food based on nondestructive analysis techniques: A review. *Critical Reviews in Food Science and Nutrition*, *61*(14), 2351-2371.

Wani, A. L., Ara, A., & Usmani, J. A. (2015). Lead toxicity: a review. *Interdiscip Toxicol 8* (2): 55–64.