iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** V **Month of publication:** May 2023

DOI: https://doi.org/10.22214/ijraset.2023.53055

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue V May 2023- Available at www.ijraset.com

Examination of Adulterants in Edibles

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Abstract: ***Edible substance adulteration is a serious problem for modern food safety. The obvious cause of concern may be that adulterants have detrimental impacts on human health. One of the most tainted food products is edible oils. The perpetrators are using strategies that successfully hide the presence of the adulterants from existing methods for detecting oil adulteration and human organoleptic limits. This review includes a thorough account of the research done over the past three decades on the falsification assessment of edible oils using chemical, biosensors, chromatography, spectroscopy, differential scanning calorimetry, non-thermal plasma, and dielectric spectroscopy, as well as a collection of patented methods for detecting oil adulteration. The detection methods examined have certain benefits and some drawbacks, although chemical testing are straightforward; nuclear magnetic resonance and biosensors, dielectric spectroscopy is quick, portable, and compatible with the internet, but the findings can vary depending on the electric current frequency and internal parameters (moisture, temperature, structural composition). Copies are extremely accurate but have prohibitive costs. For scientists or those interested in learning more about the latest methods for detecting adulterated edible oil, this review paper can be helpful.***

I. INTRODUCTION

Food, which is made up of carbohydrates, water, fats, and proteins, is one of the fundamental necessities for all living things and can be consumed for both nutrition and enjoyment by all animals, including humans. Food products have always been susceptible to adulteration or fraudulent admixture with substandard inferior components. Food adulteration and contamination of necessary foods, which can serve as a potential source of disease infection or hazardous poisoning, are an increasing problem in India. The prevention of food adulteration depends heavily on customer awareness. Unawareness and unjust business practices could threaten customer health, and deception could result in poisoning. Therefore, the general public should be aware of simple screening procedures. The Canadian government issued a warning to its residents in September 1998 not to eat any food that had been cooked or processed in oil from India because it might have been tainted with argemone. In order to increase their earnings, dishonest traders in north India combined the lethal argemone oil to mustard oil, resulting in dozens of deaths or paralysis. In India, the value of human life is so low that it was just written off as another tragedy. Synthetic chemicals and detergent powder are being added to milk to adulterate it, which could result in permanent harm. It is yet another successful enterprise.

Your appetite almost becomes insatiable as you browse the market and witness the beautifully decorated sweets and other foods. That is exactly what it intends to do to you. entice you to shop and eat. But hold on! While doing so, you might be consuming "Metanil yellow," a prohibited coal tar dye also known as "Kishori Rang," "Rhodamin-B," "Lead Chromate," or even "Ultra Marine Blue." All of these are prohibited and illegal colours that pose serious health risks and may eventually lead to cancer. They cause cancer. We might be consuming harmful dyes, sawdust, soapstone, industrial flour, aluminium foil, and even, would you believe it, cow poo! Instead of promoting health, invite sickness.

Food adulteration is the reduction or degradation of food quality by substituting food ingredients, adding uncertified substances, or removing essential ingredients from food for profit or other random reasons. It is the process of making Food adulteration ultimately misleads consumers and leads to a variety of health risks. Finding a tamper-free food industry today is very difficult. For this reason, the growing number of food manufacturers and the pending levels of food imports mean that manufacturers may mislead or defraud consumers, so consumers may find common adulterants and its impact on health.

II. WHY FOOD ADULTERATION?

Adulteration has long existed in society but has been overlooked due to its low use and impact. According to studies conducted, 70% milk contains water, 43% turmeric powder contains chalk powder, 100% red chili powder contains artificial colours, and 37% sugar contains chalk powder found The main reason for attracting adulterers is to increase their cash income by increasing their volume. Even though increased profit margins by some self-serving manufacturers, processors and retailers have triggered counterfeiting, the main causes of counterfeiting are fraud and lack of random quality assessment of questionable products.

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As the world's population grows at an alarming rate, food is often adulterated in order to meet the needs of this growing population and feed a large population. Another motivation for counterfeiting and adulteration of goods and services is outsourcing to offshore producers. Labour is relatively cheap in some countries making outsourcing possible. This also makes it easier to counterfeit products, as the cost of production is much less than the super-normal profits you get.

Food and beverages are generally adulterated for five reasons: these are:

1) If demand exceeds supply in the market,
2) Reduce production costs to compete with market competitors,
3) Desire for higher profit margins,
4) Lack of trained staff with outdated food processing techniques;
5) Unaware of outbreaks of food adulteration.

A. Types Of Adulteration

1) *Intentional Adulteration-* Intentional adulteration is the intentional adulteration of food. It is the incorporation of inferior substances that have similar properties to the food to which they are added. Therefore, they are difficult to find. Contaminants can be physical or biological in nature. It is done to increase the level of essential nutrients after a certain amount of reduction, increase profit margins through various chemicals such as urea, melamine, etc., and add substances such as starch, flour, sugar cane, etc. to increase volume. Vegetable oil , water, skim milk, sand, chalk flour, molasses, stone, brick flour, ergot, chicory, roast Barley flour, ground papaya seeds, etc. It is converted into various foods. It is the most dangerous form of adulteration, as it is carried out by business-minded people who have simply forgotten the humanity behind the money-making ethos .

2) *Incidental Adulteration-* Adulteration due to lack of food and beverage hygiene throughout the production facility down to the serving table. Incidental contaminations include pesticide residues, rodent shedding, and larvae in food. Metallic contamination with arsenic, lead, and mercury can also occur incidentally. Unintentional contaminants also include pests such as rodents and insects. These pests are highly invasive and produce pollutants in the form of faeces, body excreta and microbial decomposition. The most common incidental contaminants are pesticides, D.D.T. and residues on plant products. The maximum allowable limit for D.D.T. is 3 ppm, which can be exceeded .

III. METHODOLOGY

While working on this project, I carried out some adulteration tests on different edible items using DART test book, chemical tests and some of the tests were performed using different types of instrumentations.

A. Dart Book Test

1) *Detection Of Starch, Detergent And Other Chemicals In Milk-*

Take some amount of milk in glass and add same amount of water to it
Shake them completely
If the milk is adulterated with detergent then it will form a dense lather
The milk in the image shows that it is a pure milk.



2) Detection Of Added Colour In Food Grains-

Put few food grains in a glass of water.
Wait for some time.
If the grains leave colour, then it is adulterated
Pure food grains won't leave colour.



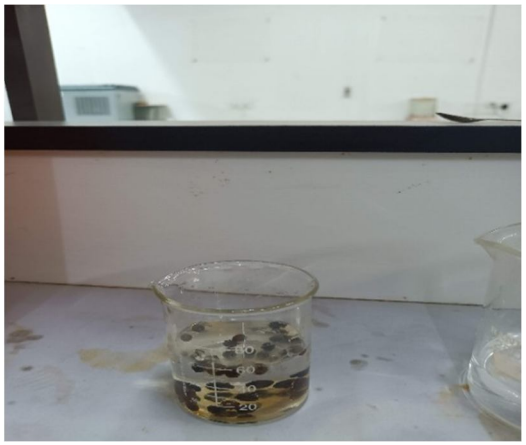
3) Detection Of Chicory Powder In Coffee Powder-

Add a teaspoon of coffee powder in a transparent glass.
Add some water.
Coffee floats over the water whereas chicory sinks.



4) Detection Of Papaya Seeds In Pepper Seeds-

In a glass of water add some papaya seeds
Wait for some time.
Adulterated pepper with papaya seeds will float
Pure papaya seeds will settle down.



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B. Some Chemical Tests Were Also Performed On Spices-

1) Test Procedure for Metanil Yellow

Approximately 0.1 g of turmeric sample was placed in a test tube and approximately 1 ml of propanol was added to dissolve the sample. We added 5-10 drops of HCl to the sample and observed the color of the sample. The presence of a pink tint indicates the presence of methanil yellow.

2) Test Procedure for Sudan Dyes

Take 1g of suspect chili powder in a test tube, add 2mL of hexane and shake well. I was able to calm down. Decant the clear solution into another test tube and shake well. The appearance of red color in the bottom acetonitrile layer indicates the presence of Sudan pigment.

3) Test Method for Artificial Colours

Fragrance samples are extracted with petroleum ether. 13 N sulfuric acid solution (88 ml concentrated Sulfuric acid diluted with 250 ml of distilled water. water). Red colour seems to remain even after adding Dist. Water indicates the presence of artificial colouring. If red when adding Dist. No colour distortion in water, sample.

IV. INSTRUMENTAL ANALYSIS

A. Preparation of Sample (Pesticides) for Honey, Milk, Oil (Mustard):-

1) Take 2.0 gm of Homogenized sample in a 50.0 ml Polypropylene tube.
2) Add 10 ml Milli Q Water and mix well.
3) Add 10 ml Acetonitrile and mix well.
4) Vortex for 5 min.
5) Add QuEChERS extraction kit, EN 15662 method, Kit Contents: 4 g MgSO4, 1 g NaCl, 1 g Na Citrate, 0.5 g disodium citrate sesquihydrate) and vortex for 2 min.
6) Centrifuge for 15 minutes at 5000 rpm at 8 degree Celsius.
7) Transfer Upper layer into Tarson Tube Consist PSA-300 mg, C18-200mg, Mgso4-500mg) and Centrifuge it 5 min at 6000 RPM.
8) Dry 2.5 ml of aliquot (Upper Layer) on nitrogen concentrator at 40 degree Celsius and Reconstitute with 0.5 ml with Ethyl Acetate.
9) Inject on GC-MS.

B. Instrumental conditions

GC System
Instrument used : Agilent GC-7890 with Auto sampler.
Column used : HP-5MS UI 15m, 0.25µm, 25 mm ID Capillary column
Column temperature : 350 0C
Run time : 19.26 minutes.

C. Inlet Program

Mode : Split less
Flow : 1.0 ml/min
Mode : Constant Flow
Gas type : Helium

D. Auto Sampler Program

Sample washes : 3
Sample pumps : 6
Injection volume : 2.0 µl
Syringe size : 10 µl
Post injector solvent A wash : 4

Post injector solvent B wash : 4
Viscosity delay : 0 seconds
Plunger speed : Slow
Pre injection dwell : 0.00 min.
Post injection dwell : 1.00 min.

E. Oven Program

	Rate (ºC/min)	Value (ºC)	Hold Time (min)	Run Time (Min)
Initial	-	70	1	
	40	180	0	
3.75				
	5	220	0	
11.75				
	10	285	1	
19.25				

Pictures (QuEChER Pouch)



F. Summary Of Result

Compound	Honey Zandu	Honey Dabur	Oil tej	Oil Kanodia	Milk T	Milk Ananda
Chloropyrifos	8.22 mcg/kg*BLQ	2.58 mcg/kg*BDL	ND	ND	ND	ND

Remaining Organochlorine and Organophosphorus Pesticides are not detected in the Sample namely Honey, Oil, Milk.
Abbreviation:
Limit of Detection: 5 PPB
Limit of Quantification: 10 PPB
*BLQ= Below Limit of Quantification
*BDL=Below Limit of Detection
ND=Not Detected

V. LITERATURE REVIEW

"Economic Impact of Food Adulteration: A Review" is the title of the article. (Year: 2020)
Summary: The economic effects of food adulteration are the primary topic of this review paper. The financial effects on different stakeholders, such as consumers, producers, and the government, are examined. The report emphasises the costs of foodborne infections, diminished customer confidence, product recalls, and legal repercussions. In order to lessen the financial burden of food adulteration, the essay emphasises the necessity for strong regulatory measures and investments in food safety systems.
"Food Fraud: Types, Detection, and Prevention" is the title of the article. (Year: 2021)

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Summary: This article examines many forms of food fraud and offers a detailed examination of each, including adulteration, mislabeling, and counterfeiting. It goes on the methods for spotting food fraud, including spectroscopy, isotope analysis, and DNA testing.

In order to effectively tackle food fraud, the report also offers preventive methods including stronger laws, supply chain transparency, and raised consumer knowledge.

"Food Adulteration and Food Safety in Developing Countries: A Review" is the title of the article. (Year: 2018)

Summary: The challenges related to food adulteration, notably in developing nations, are the subject of this review. It draws attention to the difficulties these areas confront, including their little resources, inadequate regulatory systems, and lack of enforcement. The research investigates the health effects of eating tainted food and highlights the necessity of international cooperation, information exchange, and capacity development to solve issues with food safety in poor nations.

HOW TO PREVENT THIS MENACE CALLED FOOD ADULTERATION-

Detailed root cause analysis reveals various reasons behind food adulteration clearly. The main problems that can be observed in this sector are related and possible solutions.

They are:

1) Improvement of storage facilities One of the biggest problems with grains, legumes and spices is insects. Intrusion due to damp and unsanitary conditions in the warehouse. Recommended workaround: Food grain storage needs to be closely monitored by professional people By separating the grain from the incoming grain, there is an opportunity to improve grain quality. Outgoing pattern with dates so that "first in, first out" can be applied here So, Further care should be taken to ensure that insect-infested crops are not affected by the field. Arrive at the warehouse as it can prove to be a threat to healthy grain. Be especially careful during monsoon season and in areas with high humidity Don't let the beans rot.
2) Improved handling Grocers should be well trained in grain handling to avoid damage Loss of grain or quality.
3) Prevention of contamination by foreign substances, oils and fats, rice flour, etc. Substances for financial gain by selling food of lower quality at a higher price. In Japan, food adulteration is prevalent for economic reasons. maybeIt is managed with triple technology through joint efforts of consumers, food sellers and food manufacturers and government.

First, consumers should be encouraged to pay attention to the food they buy or are purchasing and consumption. DART books should be publicly available

Advertisements and housewives may be motivated to do these tests. Every slight instance of food adulteration they encounter. all such Efforts are possible only if consumers are aware of the negative effects of consumption Adulterated food. Second, FOSTAC training should be provided and educated to food vendors. Educate them about the ill effects of adulteration and the penalties they must pay If found guilty, we encourage you to engage in fair trade practices. Third, the government can open a "counterfeit intelligence agency" where people can report Food adulteration cases directly. Governments can also carry out raids or sudden. Visit warehouses and places where food is stored to see if conditions are correct appropriate. analyze food samples from various suppliers, Strict measures must be taken if contamination is detected.

VI. CONCLUSION

Food adulteration can have a huge impact on our health without us even knowing it. Some prudent measures taken by our society can prevent that. Rising food prices should be controlled by the government. Consumers should avoid purchasing food from places where proper hygiene is not observed. Both local grocers and branded grocers are required to be inspected by government agencies. If we tend to be active participants in these changes, we can create a healthy and risk-free future for the next generation. Food adulteration has been a problem since the dawn of civilization as it not only reduces food quality but also has many adverse health effects. Determining value and protecting consumers from fraud requires authentic testing of food and proof of adulteration of various foods. Food safety and regulatory concerns have ensured the development of various techniques to detect adulteration in food, including physical, biochemical/immunological, and molecular techniques. Molecular methods are preferred for detecting biological contaminants in food, and physical and biochemical methods are preferred for detecting other contaminants in food. Providing health education to food manufacturers and consumers about the harmful effects of various contaminants in food is very important. Be careful not to purchase large quantities of milk or other foods from unauthorized sources. It is essential to conduct regular quality control tests to ensure that food intended for human consumption is free of adulteration. Food adulteration is an evolving concept due to improved contaminant detection methods (“we are finding more scams”) and increased opportunities for fraudsters to profit from their crimes (expanding global market). Food adulteration risks are considered across the spectrum of food protection, including food quality, food safety, food fraud, and food Défense.

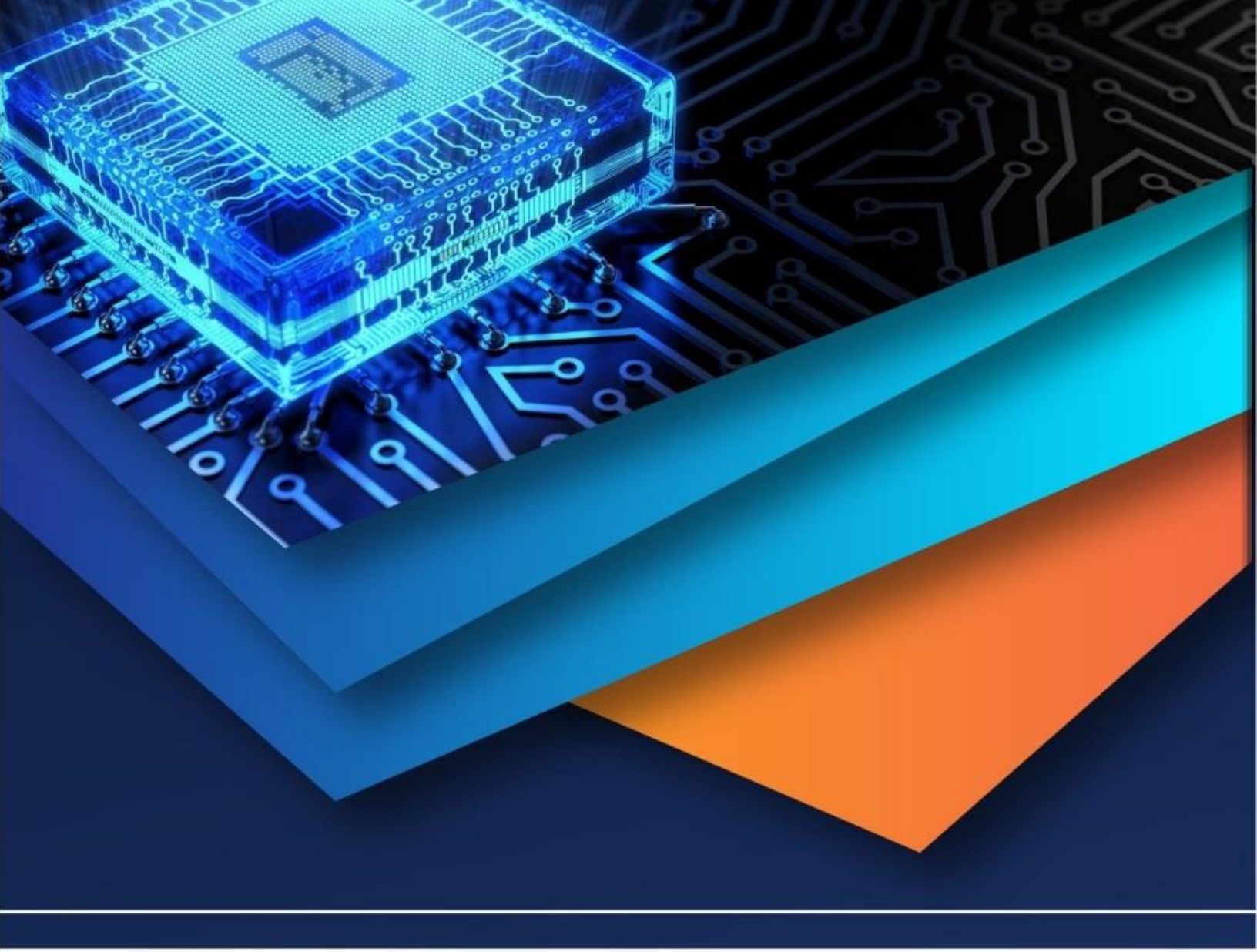
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Foods that pose a public health hazard are classified because of adulteration, but there are many different types of causes and motives. Food fraud is a broader term that includes the causes of incidents. To stay ahead of the growing scope, scale and threats, new mitigation approaches are being developed to detect and mitigate them more efficiently and effectively.

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