Food Adulteration in Bangladesh

Types, Health Consequences, and Prevention

Food Adulteration in Bangladesh:
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Subject: Submission of Project Report on "Food Adulteration in Bangladesh: Types, Health Consequences, and Prevention."

I am pleased to give the project report, under the title, *Food Adulteration in Bangladesh: Types, Health Consequences, and Prevention*. The report is written according to the project requirements and provides in detail review of food adulteration practices that are prevalent in Bangladesh and health hazards that it causes and preventive and consumer awareness strategies.

The paper will look at the short- and long-term effects of food adulteration like the one that has been experienced in milk, spices, oils, beverages and snacks etc. Recommendations that can be applied in improving food safety, minimizing the health risks, and promoting safe eating are also offered in the paper.

I want to add that this project enabled me to contribute to the improvement of my knowledge regarding the food safety problems and the necessity to be proactive. I indeed hope that the observations and recommendations made in this report will contribute significantly to the future of the debates on the subject of food safety and health among the citizens of Bangladesh.

I think the report is not only as per the academic requirements, but also, I would be happy to get a feedback or suggestions that would enable me to improve on the quality of the work. I like you to be spending your time and thinking.

Sincerely Yours,

Sharmin Haque Swim

ID: 111 221 024

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Declaration of the Student

I certify that the study and discussion in this project report about the food adulteration in Bangladesh, its nature, health effects, and preventive measures are my own work and it was done under the guidance of Dr. Khandoker Mahmudur Rahman, Professor, School of Business and Economics, United International University (UIU),

I testify that everything said, analyzed, and concluded in this report is founded on my personal research and observation. All the references, data or theoretical frameworks employed in this study have been referenced and acknowledged correctly in compliance with the academic integrity standards.

Moreover, I affirm that this project report has not been filled in any other organization, either in Bangladesh or elsewhere, to receive a degree, diploma, or certification. I have very much adhered to the guidelines and regulations provided by United International University in writing this.

I would have full responsibility and accountability to the contents of this report and that it complies with the best academic honesty principles.

Acknowledgement

First, I would like to thank Allah (SWT) who provided me with the opportunity, support, and motivation to complete my studies on schedule and to pass them.

I would like to take this opportunity and thank my supervisor, Dr. Khandoker Mahmudur Rahman, Professor at the School of Business and Economics, at the United International University. It is an absolute necessity that had to be guided by him, supported, and encouraged at all times in this project. With his help, I have been able to do this study and I am a fortunate person to have him as a supervisor.

My family has also been of great help in my pursuit of a Bachelor of Business Administration (BBA) degree since the whole process has been paved with support, understanding and encouragement.

In conclusion, I should like to take this time to thank all those who will read this report now or in the future.

Abstract

The adulteration of food is a critical social issue in Bangladesh because it directly influences the food safety, consumer confidence, and health in general. This report focuses on prevalent food adulteration activities in the country, types of food that are typically adulterated, adulterating foods and adulterants, consequences of food adulteration to human health and the existing prevention and regulation measures. The research is grounded on secondary data which is gathered by accessing published articles of research, government reports and other literature that constitutes real life patterns of food consumption in Bangladesh.

The observations show that milk, fish, fruits, vegetables, spices, edible oils, and bakery products are common foodstuffs that are often contaminated with toxic chemical food additives and preservatives. Formalin, artificial colors, chemical preservatives, and other unpleasant substances are the most common adulterants, and are generally used to enhance appearance and shelf life, as well as profitability, although these substances are extremely harmful to the health of consumers. The illnesses include both short-term (food poisoning, diarrhea, and allergies) and long-term (organ damage, cancer, and developmental disorders) consequences of the health.

There are also major gaps in consumer awareness and a lack of effectiveness in the effective implementation of food safety laws, which is also highlighted in the report. Despite regulatory mechanisms like the Bangladesh Food Safety Act and the Bangladesh Food Safety Authority, there is still a problem in the monitoring, laboratory facilities, inter-agency coordination, and the adherence of food manufacturers and sellers.

This research concludes that food adulteration in Bangladesh has to be solved by enhanced implementation of rules and regulations, better inspection standards, more awareness among people and ethical food manufacturing that is sure to produce safe and nutritive food to all.

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Chapter 1: Introduction

1.1 Background of the study

Food adulteration in Bangladesh has become a clear and growing socio-economic issue of public health concern that poses significant threats to the personal wellbeing as well as the quality of the food chain. The high rates of urbanization, population growth, and large-scale demand of various food commodities have created a condition where malpractices, like use of toxic chemicals, artificial colorants and poor-quality food additives, have become famous in many markets. Such malpractices are often driven by an imperative to make profits and as a result, a lack of seriousness in the implementation of food safety laws.

It has been empirically observed that adulteration is rampant among staple products which form the daily food of the Bangladeshi people. All edible foods are prone to the introduction of detrimental contaminants such as milk, spices, edible oils, fruits, vegetables, beverages, and processed snack foods. Both acute effects of ingesting such adulterants (food-borne diarrhoea, vomiting, and dermal or ocular irritation) and chronic effects (hepatotoxicity, carcinogenicity and a spectrum of metabolic diseases) have been linked to the ingestion of such adulterants. Although regulatory structures exist to help in protection of food safety, there is lack of consumer awareness and proper surveillance mechanisms that help in perpetuating such harmful practices.

The consequences of food adulteration are not just a morbidity problem in the individual level, but a physical force on the health outcomes and economic productivity of nations. Lapsed food safety increases spending on healthcare, reduces workplace productivity, and deteriorates the quality of life in general. It is therefore crucial to fully comprehend the processes which trigger food adulteration, the health consequences which are associated with it and the preventive measures which can be effectively employed in order to make appropriate policies in the field of health to the people.

This current study aims to outline a description of the current food adulteration practices in Bangladesh, evaluate the possible health outcomes of the practices and give practical measures of

intervention to promote healthier consumption habits. The study attempts to enrich consumer awareness by shedding light on these issues and add value to scholarly and policy-making discussions on improving food safety and health of the nation.

1.2 Data Collection

The report employs several techniques of data gathering in order to explore the problem of food adulteration in Bangladesh. In order to come up with a good conceptual and theoretical base, a comprehensive literature review, using academic journals, books, research articles, and past project reports were used and searching reliable sources like Google scholar and university databases. These sources have given important information on the nature of food contamination, food products that are usually contaminated and their health implications.

The secondary data were also obtained based on the reports that were released by state organizations, regulatory bodies, and health institutions, a report on food safety laws, regulations, and enforcement mechanisms in Bangladesh. Moreover, the articles in reputed newspapers, research-based websites and reports on consumer rights groups were also examined to get knowledge on the current trends, public awareness and actual occurrence of the food adulteration.

Besides, statistical data concerning the contamination of food, health hazards and the inspection of food safety were analyzed to verify the results of the research. The data collected were screened and interpreted to bring accuracy, relevancy, and reliability thus reinforcing the general conclusions and recommendations of the report.

1.3 Methodology

The current study will use a descriptive and qualitative research design to examine the current food adulteration practices in Bangladesh, health effects, and potential preventive strategies. The methodology has been structured in a way that is bound to have a methodical collection and analysis of the relevant information in accordance to the objectives of the study.

The study is mainly grounded on secondary data that were gathered out of diverse sources that are credible. They are academic journals, books, research articles, government works, policy works and reports submitted by food safety organizations and public health services. The information on the current issues on food adulteration was also collected using online scholarly web sites like Google Scholar, and reliable newspapers and websites that rely on research carried out on the topic.

In order to increase the validity of the research, only the recognized and authentic sources of data were selected. The information obtained was discussed, compared, and analyzed in detail to see occurring patterns, adulteration types, health risks, and preventive measures. The data was interpreted through the qualitative analysis methods to make significant conclusions.

The approach also takes into account the current laws and regulations used to assess food safety in Bangladesh so as to measure the effectiveness of the existing preventive measures. Lastly, the results were listed in a logical order that was presented in an orderly way to ensure clarity, consistency and academic significance.

1.4 Objectives of the Study

This research will have the following specific objectives:

- To determine and classify the most common types of food adulteration activities in Bangladesh, specifying the materials involved and the type of food that was contaminated.
- To examine the adverse short and long-term health outcomes of using adulterated food by the general population, specifically vulnerable populations.
- To critically address the current enforcement framework, legislations as well as policies and enforcement systems, with regard to food safety in Bangladesh.
- To explore the causal factors that ascribe to the widespread nature of food contamination in the Bangladeshi setting.
- To recommend holistic and practical prevention measures, including policy changes, technology, and education of people, to improve food safety in Bangladesh.

1.5 Scope and Limitations of the Study

Scope of the study:

This paper is devoted to the problem of the food adulteration of Bangladesh and attempts to comprehend the extent to which the problem is serious and common. It examines the popular forms of food that are widely adulterated and how and why the adulteration is a continued practice. The research primarily focuses on an intentional adulteration process in which, persons put harmful components into food to gain profits, to enhance the appearance or to prolong the shelf life of the food item.

The paper discusses various varieties of food items that the people of Bangladesh consume on a regular basis including milk and dairy products, fish, meat, fruits, vegetables, spices, rice, sweets, edible oils, and bakery products. In research, these foods are mostly reported to be susceptible to contamination. The paper will describe the usual impurities present in these products such as the chemical preservatives, artificial colors, formalin, carbide and other artificial ripening agents. It also describes how corrupt traders combine or add these substances.

The other key component of the study is the health effects of adulterated food. It provides explanations of the short-term effects such as stomach problems, food poisoning and allergies, as well as long term effects such as kidney damage, liver problems, risk of cancer, and developmental problems in children. Special focus is put on vulnerable populations that include children, pregnant women, and the older population, as they are more prone to severe health effects.

The existing laws and the regulatory bodies that are in place in Bangladesh regarding food safety are also reviewed in the study. It talks about the operation of these institutions, their advantages and the hurdles they have in regulating food adulteration. Weaknesses in their enforcement, surveillance and social awareness are also mentioned.

Lastly, the paper provides a few of the practical and evidence-based recommendations to minimize food adulteration. These involve enhanced enforcement of the law, enhanced oversight systems, enhanced awareness among the people, and more coordination between the governmental agencies and the food producers. In general, the research will help to give a clear picture of the issue, as well as propose realistic solutions to the improvement of food safety in Bangladesh.

Limitations of the Study:

Even though this investigation offers a general overview of food adulteration in Bangladesh, it has a number of limitations that can be considered. To start with, the research is mostly founded on secondary sources. It lacks primary data collection by way of field survey, interviews, laboratory experiments or direct observations. Consequently, the results are subject to the accessibility, precision, and extent of the information that has been published before. Any loopholes, contradictions, and biases in such sources can also affect the general findings of this study.

Secondly, lack of sufficient and full-time countrywide data in Bangladesh complicates the measurement of precise prevalence of food adulteration and its overall economic effect. It is hard to establish the number of diseases or health related conditions caused directly by adulterated food because of underreporting, absence of proper diagnosis and poor surveillance systems.

The other limitation is that the study recommends a number of preventive strategies and policy recommendations which cannot be implemented in practice as long as there are other factors not included in the study. Problems like political commitment, administrative effectiveness, control of corruption, sufficient funding, awareness among the people and the collaboration of the stakeholders are also important to the successful implementation. These social and socio-economic aspects cannot be completely considered in the context of a literature-generated review.

Moreover, the research primarily focuses on anthropometric effects of food contamination. Though the environmental outcomes and specific microbiological contamination routes are recognized as a significant part of food safety, they are not discussed in-depth. The interest is still mainly on the chemical adulterants and health issues of the population instead of environmental pollution, ecological harm or sophisticated scientific examination of contamination processes.

Regardless of these shortcomings, the study nevertheless offers significant information about the existing state of food adulteration in Bangladesh, and the directions where the primary research and policy agenda needs to be advanced.

Chapter 2: Literature Review

2.1 Introduction to Food Adulteration

The issue of food adulteration has become a prominent concern on the health of the population in Bangladesh, both in the quality and safety of the food served (M. A. Rahman et al., 2015; Tamanna, 2024)It can be described as the intentional introduction or replacement of harmful, inferior or unapproved substances into food items with the intention of generating economic value, at the expense of nutrition and safety. The practice does not apply to any type of food but instead to both the staple foods, including rice, flour, and pulses, as well as the perishable foods, including milk, fish, fruits, and meat (Moonajilin et al., 2018; Yeasmin et al., 2023).

Several reasons promote the widespread adulteration. Economic forces force sellers and small-scale manufacturers to cut corners in order to save or make more profit. Informal markets in most instances are an under-regulated market whereby compliance to food safety standards is low (Nasreen S and Ahmed, 2014; N. E. Rahman, 2018)). Low awareness and the inability to detect adulteration with the naked eye by consumers also make them vulnerable. This in turn makes the food supply chain a channel through which unsafe practices are practiced that influence health and nutrition of the population.

Various types of adulteration have been recorded widely such as chemical, physical and biological adulteration. A particularly dangerous type of food adulteration is chemical one, e.g., using formalin in fish and fruits or synthetic dyes in sweets and beverages, as it is both dangerous in the short-term and in the long-term (Moonajilin et al., 2018). Physical adulteration, such as adding sand, husk or dust to the staple foods such as rice and pulses, lowers nutritional value, and deceives the consumer on the quality. Bacterial contamination of milk or any other substance (fungi) in stored grains are considered biological adulteration that also undermines the safety of the food and may cause food poisoning(Arefin et al., n.d.).

The threat posed to food adulteration is not only on health but on social and economic aspects in a wider context. Further, it impacts disproportionately on the vulnerable population such as

children, the elderly, and low-income families who might not access the safe and regulated food supplies.

Besides health and economical effects, food adulteration is one of the indicators of a systemic issue associated with implementation and control difficulties. Despite the laws enacted by Bangladesh against adulteration, including the Food Safety Act, 2013, the prevention of adulteration is not effective due to factors like inadequate monitoring, lack of resources, and empty pockets on consumer education(Noman & Ali, n.d.; N. E. Rahman, 2018). This points to the serious necessity of multi-dimensional interventions, i.e. the implementation of stringent laws, educational campaigns among the population and moral responsibility of the manufacturers and sellers.

Accordingly, it is important to document both prevalence and type of food adulteration but also investigate health, social and regulatory consequences of food adulteration. The purpose of the literature review is to present an overview of the problem on an international level and a local one, taking the situation in Bangladesh, to offer an effective plan on how to protect the general health of people and provide food integrity.

2.2 Global perspective on food adulteration

Food adulteration is not an issue that is confined to Bangladesh as it is a phenomenon that occurs in all countries regardless of their income but the degree and nature of adulteration vary. Regulatory systems are weak; the levels of consumer low awareness and economic pressures are typical factors in most developing countries. Cases of labeling and contamination have raised concerns of public health even in developed countries. The systematic review regarding fish adulteration reveals the scope of mislabeling, chemical pollution and species replacement that happens not only locally but also internationally either in the product being sold locally or in the product being sold overseas (Khan et al., 2023). Bangladesh is experiencing certain difficulties when compared with other nations due to the existence of informal street food vendors, lack of laboratory analysis and disturbances in the application of food safety laws. Examples of the international practices (traceability systems, educating the population, etc.) can assist in enhancing

the regulatory framework in Bangladesh (Moonajilin et al., 2018). These comparisons bring out the fact that food adulteration is a systemic issue, and it will require a combination of regulation, monitoring and consumer education to secure proper protection against food adulteration.

2.3 Food adulteration scenario in Bangladesh

The issue of contamination of food in Bangladesh is not only in the official supermarkets, but also in the informal markets such as bazaars. Research in Dhaka demonstrates that (Yeasmin et al., 2023)milk, meat, juices, and processed foods are frequently processed with a mixture of other foods.

(Moonajilin et al., 2018) discovered that Savar Upazila has the highest rampant milk adulteration as they are adding water and destructive chemicals to add volume. In addition, it is proved by historical trends that the urban consumers tend to consume polluted products unconsciously due to the lack of awareness and the inability to label the products(Nasreen S and Ahmed T Food Adulteration in Dhaka City, n.d.). It is particularly high in the rural and peri-urban regions due to the fact that there is weak monitoring of the market and the enforcement of the rules is undeveloped. Food vendors also apply synthetic colors, chemicals to preserve foods and enhance the taste in order to appear good and last longer. The practices not only interfere with the nutritional value but it is also detrimental to the health of the populace. The problem is also aggravated by the cultural orientation towards products that are cheap and beautiful. Together, the evidence provided above indicates that the food safety problem in Bangladesh is not just wide-spread but also multidimensional and should be addressed with interventions of different dimensions (regulation, education, and monitoring).

2.4 Types of food adulteration (based on past studies)

In academic literature, the taxonomy of the adulteration techniques employed in Bangladesh is highly detailed, showing a great degree of sophistication when it comes to the process of food adulteration in order to make an illegal profit.

There are several products and practices of food adulteration in Bangladesh. Most people use water to dilute milk or add chemical food preservatives (Islam et al., 1970; Moonajilin et al., 2018). Juice products can be artificially colored, loaded with sugar or other chemical substances. Meat also has been replaced by other species of lower quality or is injected with water to gain weight. Most street foods usually have non-approved dyes, flavor additives, and preservatives to enhance the appearance or flavor (M. A. Rahman et al., 2015). There is also a record of fish adulteration such as chemical contamination and species replacement(Khan et al., 2023). Due to a longer shelf-life or more color, unsafe chemicals can be added to processed foods. It is critical that regulators and consumers be able to classify these practices so that they can know which products are high-risk. The knowledge of the certain types of adulteration enables specific testing, monitoring and education to reduce risks of health and economic losses.

Formaldehyde better known as formalin is one of the most infamous adulterants in the country. According to (M. A. Rahman et al., 2015). Formalin is a disinfectant of industrial strength, mostly used to preserve biological specimens and embalm but is also commonly used on fish, milk, and other fruits to prevent the process of natural decay. Due to the fact that fish in most cases will have to travel long distances to capital without any form of temperature control, the traders apply formalin in order to make the fish firm and appearing fresh over a period of few days. The literature shows that even small traces of this chemical may be extremely toxic, but being cheap and effective, it is a high demand instrument of unscrupulous wholesalers.

In order to meet the huge seasonal supply of fruit of fruits like mangoes, bananas and papayas, traders often employ Calcium Carbide and Ethephon. This enables the traders to pick green fruit and leave it to ripen overnight so that they can market it at profitable market periods. Nevertheless,

the unnatural procedure results in dangerous alkalinity residues on the skin of the fruit and in most cases, it contains harmful traces of arsenic and phosphorus.

2.5 Health impacts of food adulteration

The long-term effect of these chemicals on the Bangladesh population is the major community health catastrophe. Studies have revealed that the formalin in milk and fish is directly related to malignant tumors (in particular, in the liver, lungs, and throat) (M. A. Rahman et al., 2015). Formalin is a Group 1 carcinogen that has irreversible DNA damage. This bio-accumulation is also associated with the extreme increase in the cases of chronic kidney disease and liver failure in young people, otherwise healthy, in urban areas. This leads to failure of their internal organs which have been trying to deal with these toxins over the years.

The health consequences of food adulteration are severe, ranging from instant poisoning to long term chronic diseases. Contaminated or chemically adulterated foods can cause gastrointestinal disorders, a lowered immunity and other acute diseases (M. A. Rahman et al., 2015). For example, water and formalin adulterated milk has been related to cause of stomach discomfort, diarrhea, and digestive problems (Islam et al., 1970). Adulterated juices, meat and processed foods could be the cause of chronic kidney and liver issues as well as nutritional deficiency (Tamanna, 2024).

Street Foods are very often found to be contaminated with unapproved dyes and chemical additives for taste improvement or coloring which puts consumers at additional risk. Vulnerable populations such as children, elderly and immunocompromised people are at the greatest risks. One of the points of researchers is that it is important to learn about these health effects in order to build the policies and interventions that can safeguard the community health. The cumulative impact of the daily intake of adulterated food is a factor, which calls for an overall approach to the problem. Ensuring safer food practices can have reducing short-term sickness and long-term burdens on the health of the population.

2.6 Legal Prevention and Policies

Some of the laws and regulations that have been implemented in Bangladesh to prevent food adulteration and consumer protection include the Food Safety Act, 2013 which is the most significant one (M. A. Rahman et al., 2015). This Act offers some legal system that can be used to monitor, inspect, and control the production, storage, and sale of food products. It establishes specific standards of food quality and food safety, the guidelines of allowable additives, preservatives, and hygiene standards. Irrespective of these rules, compliance is one of the biggest issues because of the lack of inspection resources, laboratories, and the large population of unregistered food sellers (Noman & Ali, n.d.). Legal requirements, particularly those concerning bazaars and street markets, are not known to many small-scale sellers whose resources cannot allow them to comply, and this generates loopholes in regulation.

In a bid to enhance compliance, specialists propose regular training and sensitization activities to the vendors and the consumers, where emphasis is made on the legal implications of selling or buying adulterated foods (Noman & Ali, n.d.). The certification programs, labeling systems and visible inspections can serve the purpose of deterrence and enlightenment of the consumers about safe products. It is also suggested by some researches to coordinate the national authorities and the local government institutions closer to make sure that the monitoring and enforcement is similar and consistent (M. A. Rahman et al., 2015)

Moreover, legal actions can be reinforced by the awareness efforts of the population. By ensuring the enforcement of penalties in cases of violation, as well as excellent inspection, education, and certification, the system in which compliance with legal norms will not be a choice but rather a requirement can be developed. By so doing, legal systems, management, and publicity contribute to the strength of the efficient food adulteration prevention measures in Bangladesh.

2.7 Consumer awareness and regulatory responses

Fighting food adulteration has a significant contribution of consumer awareness. Research has shown that a relatively low level of awareness of the Bangladesh people, even literate urban residents, continues to exist (Arefin et al., n.d.). In the example of Sylhet City, it was established that individuals did not have adequate knowledge about proper nutrition, food safety, and hygiene (Assessment of Consumers' Awareness of Nutrition, Food Safety and Hygiene in the Life Cycle for Sustainable Development of Bangladesh: A Study on Sylhet Assessment of Consumers' Awareness of Nutrition, Food Safety and Hygiene in the Life Cycle for Sustainable Development of Bangladesh: A Study on Sylhet City Corporation, 2021). Surprisingly, even the university students were not very familiar with adulterated commonly consumed products, including fruit juices (N. E. Rahman, 2018). Poor awareness predisposes consumers to buying unhealthy foods and indirectly the vendors fail to discourage the adulteration activities. Education campaigns in the society, branding transparency and involvement of the community are the required measures to inject more vigilance and knowledge in decision-making. Research has proposed that the certification, apparent government inspections and conspicuous warnings can assist the consumer to recognize safe products. Awareness creation is therefore a highly crucial asset to legal enforcement and regulatory controls since it would allow consumers to demand safer foods. Even with stringent laws, there is a possibility that they can have less effect in the implementation of reduction in food adulteration without informed consumers

2.8 Research gap

Although the topic of food adulteration is increasingly being drawn to the attention of Bangladesh, much remains to be known and to be practiced with regard to preventing food adulteration. The majority of research is conducted on the prevalence of adulteration and records the most frequently contaminated products and the level of the issue(Moonajilin et al., 2018; Yeasmin et al., 2023). Although significant, these studies just give a picture of what is happening and, in most cases, they do not tackle the causal factors of these pressures which may be the financial strain on the vendors or informality of local markets.

On the same note, studies on health effects are more inclined to identify short-term effects, including digestive issues, poisoning, and deficiency of nutrients(M. A. Rahman et al., 2015; Tamanna, 2024). Nevertheless, little is known about the long-term consequences of constant eating adulterated foods such as chronic diseases like kidney or liver diseases, compromised immune systems and other compounded health complications. There is little or no longitudinal research on these effects and this has left policymakers with missing vital information on which to evaluate the total cost of the issue.

The other area of a big gap lies in consumer behavior and awareness. Although other surveys have already studied the level of knowledge in urban areas(Arefin et al., n.d.), little has been investigated on rural and semi-urban populations, which might be even more vulnerable because of the absence of proper monitoring and education. Furthermore, it is hardly investigated in the literature on why people still buy adulterated food even after the awareness campaign- reasons like convenience, price and trust in the vendors are not studied in depth. These behavioral patterns are important to understand in order to develop an effective and culturally sensitive intervention.

The success of the legal systems is also a major misfit. Bangladesh has passed legislation such as the Food Safety Act, 2013 (Noman & Ali, n.d.; M. A. Rahman et al., 2015), and it is not common to examine how these laws are practiced. Limited information also exists on compliance by the vendors, the effectiveness of certification programs and whether market conducts change with the knowledge of the legal rights by the populace. Also, milk, juice, meat, and street foods are well-documented sources of types of adulteration (Moonajilin et al., 2018; M. A. Rahman et al., 2015) and little is known about systematic studies on classifying all the types of adulteration in regions and seasons. Few studies have been done on chemical residues, processing food adulteration, and new methods of adulteration, and may be necessary not only to the health of the people, but also to regulatory surveillance.

Finally, there is almost no integration strategies between prevalence study, health impact assessment, consumer awareness and regulatory evaluation. The majority of the research is

piecemeal as it dwells on individual part and does not give the whole picture of the food adulteration ecosystem in Bangladesh. The mixed-method research, which entails quantitative surveys with qualitative interviews, may provide more insights and practical recommendations.

It is not only an academic exercise to fill these gaps. Lacking sound information regarding the long-term health outcomes, consumer attitudes, geographic variations, and regulatory performance, policy interventions can only be reactive, but not proactive. These gaps need to be addressed in future studies that will guide evidence-based practices, enhance enforcement, better consumer education, and eventually decrease adulterated foods prevalence in Bangladesh. To put it short, there is an urgent necessity of multi-dimensional investigation that is to fill the existing gaps in the knowledge and extend them to the practical solutions.

2.9 Conclusion of the literature review

The problem of food adulteration in Bangladesh is acute and multi-layered and impacts the health of the population, consumer confidence and the quality of food system as a whole. The issue is very broad based and encompasses milk, meat, juices, and even street foods, which is perpetuated by economic pressures, poor consumer awareness, and laxity in the application of food safety standards. Although there are efforts to regulate the market, there are loopholes in the market through monitoring, education and compliance and as such, there is a challenge of ensuring that each food product is safe.

Food safety knowledge is still low particularly in rural and semi-urban regions and this is one of the reasons why adulterated foods are still prevalent. These issues cannot be solved in a single dimension, so more tougher regulations, efficient enforcement of the rules, and general education of people with awareness and full monitoring are necessary.

Finally, this is not only a legal, technical but also a social and educational problem to reduce the adulteration of food. Bangladesh can only achieve a lot when authorities, consumers, and researchers work together in achieving high-quality and safe food to everyone. Prevention, awareness, and continuous improvement should be focused to safeguard health of the people and regain the confidence of the community in the food system.

Chapter 3: Discussion and Analysis

3.1 Adulteration Types

Adulteration of food is a historical phenomenon in Bangladesh and it affects most types of food consumed by the people. Starting with day-to-day foods such as rice, pulses, and flour, to the more perishable food such as milk, fish, fruits and meat, there is scarcely a foodstuff group that is totally devoid of contamination. The practice has over the years become highly entrenched due to the economic factors involved, absence of proper regulation as well as lack of consumer awareness.

One of the most dangerous and common forms is chemical adulteration. Unhealthy chemicals are also added to food in order to improve the outlook, the shelf life or to cut down on the cost of production. An example that has been widely reported is the use of formalin which is commonly used to extend the shelf life of fish and fruits such that even when they are spoiled, they appear fresh. Spices, sweets, and street foods are usually coated with artificial colors and dyes to make them more attractive to the sight. Other chemicals like textile colors, calcium carbide to make fruits mature and synthetic preservatives are also commonly found in markets.

Although these practices can increase the profitability of sellers, they are deadly in terms of their health effects, both in the short-term such as nausea, diarrhea, and food poisoning as well as in the long-term such as damages to the liver and kidneys, hormonal imbalances, and predisposition to cancers.

Another frequently occurring type is physical adulteration where food is contaminated by low quality food or unwanted food. Examples are the addition of sand, stones, husk, or chalk powder to rice, pulses, and flour and the addition of brick dust to chili powder. The physical adulteration of food reduces the nutritional value of food, but may also produce direct physical damage, e.g. a damaged set of teeth or the digestive tract. In addition, the consumers are economically deceived since weight and volume of the food is artificially expanded through the use of non-food elements implying that they pay to get materials that are not nutritionally beneficial.

Poor food handling, unsafe water, inadequate sanitation and poor storage conditions are some of the causes of biological adulteration. In Bangladesh, there is a high rate of sellers in the open-air markets or cooking in the streets, where they can be exposed to dust and flies and other microorganisms which are dangerous. Usually, they are bacterial contamination of milk, contaminated handling of ready-to-eat street foods, and the growth of molds in stored grains. Biological adulteration, though unintended, can be very harmful especially when it affects the vulnerable population such as children, pregnancy, the elderly, and individuals with a weakened immune system. Diseases caused by these contaminations may include mild cases of food poisoning or serious cases of gastrointestinal diseases and other chronic health conditions.

Adulteration can also occur either willfully (intentional) or unintentionally. Profit motives and no sense of moral responsibility are part of purposeful adulteration that involves adding water into fish, formalin into milk or fish or coloring turmeric artificially to make it look better. Unintentional adulteration is due to poor awareness, infrastructural problems or ineffective bacterial measures, such as keeping grains in humid conditions that promote mold, or ineffectual refrigeration of perishable foods. It is also essential to identify this difference in the sense that intentional adulteration needs to be more severely affronted in terms of legal and regulatory enforcement whereas cases occurring accidentally can be reduced with the help of education, training, storage improvements, and infrastructure.

Overall, the variety of types of adulteration and their high occurrence in Bangladesh demonstrates systemic quality of the issue, which is shaped by financial gains and cultural norms and lack of regulation. Vulnerable is any food, both long shelf food, such as rice and flour, and perishable food, such as milk, chicken, fish, and fruit. This shows that food adulteration is not only a personal problem but a social and socio-economic problem that involves concerted efforts of the government agencies, food sellers and consumers. The solution to it will include legal action, technological involvement, consumer education activities, and propagation of safe food habits nationwide.

3.2 Impact on public health

Food adulteration has long-term impacts on the population of Bangladesh that are multi-dimensional and immense to the health of the individual; including the social, economic, and national development. Short term effects of consumption of adulterated foods have immediate health effects that may include food poisoning, diarrhea, vomiting, stomachache, nausea, and even allergic reactions. Children, elderly persons and people with compromised immune systems are more susceptible since they have less means of combating infections and toxins. Cases of outbreaks of foodborne diseases are common both in the rural and urban regions that depict the pervasiveness of the issue. To illustrate this, the milk that is contaminated with detergent, formalin or any other type of preservatives may result in acute stomachache hours after being taken hence hospitalization and loss of productivity. On the same note, the localized outbreaks of diarrhea and foodborne infections are usually caused by the use of unhygienic items in street foods.

Although short-term effects are alarming, the long-term consequences are more threatening and their impact is mostly not felt until it turns into serious health issues. Excessive exposure to poisonous chemicals contained in contaminated food may result in chronic diseases like liver and kidney damages, heart diseases, hormonal disorders, disorders of the nervous system, and even different forms of cancers. Such adulterants as heavy metals, synthetic dyes and industrial chemicals may occur in body tissues, disrupting the functioning of the key organs over time, which will decrease the life span. A study conducted in Bangladesh has also shown that there is a relationship between endocrine disruption and pesticide residues in fruits and vegetables and this can lead to long-term growth, metabolic and reproductive health issues.

Adulteration of food is a severe load on the healthcare sector in the country. Repeat cases of foodborne illnesses will result in congested hospitals and clinics, and medical costs are raised to families and the state. Illness leads to absenteeism at work and school that lowers productivity and education, which is indirectly causing social and economic instabilities. The consequences of chronic diseases caused by long-time use of adulterated food burden families, especially impoverished ones financially and emotionally increasing the inequality and social vulnerability.

There are also nutritional deficiencies caused by adulteration. An illustration is the fortification of rice, flour, and pulses with starch, chalk, and husk, which decreases the nutritional value of the food products which are important food ingredients. In the long term, these shortages may undermine physical development of children, cognitive development, immunity, and expose a person to other infectious or chronic illnesses. Improved or caused by adulterated foods, malnutrition can in its turn propagate a cycle of poor health, which cuts across generations, particularly in low-income communities.

Besides the health implications, food adulteration also has a great economic impact. Families incur greater amount of money in healthcare and loss of productivity of workforce make the economy less efficient. In a place such as Bangladesh where the number of people dependent on manual labor, agriculture, and small industry is a significant percentage of the population, these economic losses are directly translated into health/lived problems. The expenditure on sickness, low production and less capacity to work affect development in a nation and increases poverty.

Altogether, the effects of food adulteration in Bangladesh are long-term, acute and systemic. It impacts physical health, nutrition, healthcare infrastructure, economic productivity and social well-being showing that it is not only an individual issue but also a serious public health and socio-economic problem. The multi-layered and widespread consequences highlight the necessity of the multi-faceted food safety, strong regulations, mass education of consumers and enhancing the infrastructure to improve the health of the population and foster sustainable development.

3.3 Legal and Ethical Considerations

Adulteration of food in Bangladesh is not only a social and health issue but also a key legal and ethical problem. Although the law has established a legal framework that governs the production, sale, and distribution of food, in the form of the Food Safety Act, 2013, we find the implementation of the act uneven. Adulterated products are still being marketed by many vendors especially in informal markets, a fact that points to the discrepancy between the law and the way things are.

This loophole casts grave concerns regarding compliance, accountability and the efficiency of regulatory mechanisms in consumer protection.

Legally, the sale of contaminated food is a contravention of human rights and the health and safety laws of the community. When vendors offer unsafe food and knowingly, they violate the law by taking up the trust of the food system. The difficulties in enforcement are in the form of limited inspection capabilities, lack of laboratory capacity and the fact that most of the local markets are informal. Also, the law is not always enforced strictly and, therefore, the deterrent effect is reduced. Tightening of regulatory control, more frequent inspections, and adding more severe repercussions in case of violation may be more effective in enhancing compliance.

Food adulteration on the ethical front denotes a lapse of proper concern of the society and ethical responsibility. Vendors and manufacturers are bound to offer safe and healthy products and as part of the enforcement, the authorities have the ethical responsibility to safeguard the health of people through appropriate monitoring and education. Consumers are usually compelled to trust the honesty of the vendors and this is quite a problem especially in cases where the consumers lack understanding of adulteration or lack of labeling of their products. Both professional malpractices and personal misconduct lead to not only undermining the health of people, but also undermining the integrity and equity of the market.

The solution to these problems needs to be multi-dimensional. Strict legal measures should be increased but it is not enough. Training and awareness campaigns among vendors and manufactures on matters that relate to ethical awareness should be encouraged and compliance rewarded. Consumers can make safer decisions and promote business ethics through transparency mechanisms (including labeling, certification initiatives and publicly reporting violations). Making the population aware of the legal rights and food safety standards also helps to enhance responsibility and ethical conduct.

Moreover, the consumer behavior and social norms are closely interconnected with the legal and ethical aspects. As per our findings, despite the existence of laws, there might be a tendency to accept minor adulteration in social or financial interests, which may lead to unsafe practices. Thus, law and ethics and social approaches should collaborate: law establishes norm, ethics governs actions, and social conscious makes people obey.

Lastly, the combination of legal and ethical aspects of food safety into community education and the public policy can establish a comprehensive approach to food safety. Bangladesh can be shifted towards a more responsible and transparent food system by harmonizing enforcement or compliance, ethical responsibility, and consumer empowerment. By so doing, the war to eradicate food adulteration would not only be a matter of regulation but a collective responsibility of all members of society including authorities, vendors and consumers.

3.4 Consumer Awareness and challenges

Despite the high prevalence and severity of food adulteration in Bangladesh, there is still a very low consumer awareness. The majority of people lack knowledge on how to recognize adulterated food and they are not fully aware of the long-term health consequences of chemical, physical or biological contaminants. In many cases, adulterated foods can appear, smell, or be normal to taste and, therefore, it is challenging to make safe decisions as a consumer.

Consumer behavior is largely influenced by economic factors. The affordability is a priority of the low-income families because they do not have sufficient resources. This makes them buy their food at informal or local markets where food safety standards are not properly monitored and enforced. Alternatives are often more costly even where safer alternatives exist and therefore low-income households are more susceptible to taking contaminated foods. Such trend is especially common in regions where there are fewer options on certified or branded food products.

The other barrier is the lack of trust in food regulatory bodies. Bangladesh has food safety legislations, but the laws are not well enforced, very infrequent inspection, and few laboratories. Consumers normally question the effect of reporting adulterated food will have any consequence. This suspicion lets the illegal practices go on unchecked and it deters business involvement of the community in the food safety process.

Consumer awareness is also affected by culture and social factors. Most individuals tend to trust in the conventional ideas or the outlook of food to determine quality. As an example, sweets in bright color or artificially polished rice might be considered of high quality, whereas such looks are usually the products of harmful additives. The reliance on traditional local suppliers may also contribute to the development of dangerous habits of consumption, affecting consumers who are confident in the safety of their suppliers and do not wonder about it.

Restrictions in education make the situation worse. Literacy levels are low making many consumers not able to get information on food adulteration and its effects. When done, awareness campaigns may not work unless they are done with consideration of the level of understanding of the audience or communicated in the local languages. Even educated citizens might be unaware of how to detect adulteration or react to it in an appropriate manner without the proper education.

Vulnerability is also enhanced by technological constraints. Bangladesh does not have access to the tools of detection that are consumer-friendly as in other developed countries. There is no easy testing device, mobile application or quick testing to detect adulterants, and consumer is fully reliant on the goodwill of the vendor. It is because of this technological disparity that it is almost impossible that ordinary households can try to understand food safety either prior to buying or consumption.

The problem is also caused by psychological and behavioral factors. A significant number of consumers do not pay enough attention to the danger of food adulteration because they think that

the occasional use would not be harmful. Others are too weak to change the system or take the view that there is a government body with the mandate to do all the food safety. These attitudes minimize the chances of being proactive, including reading labels, asking suppliers questions, or taking part in community-wide surveillance.

The issue of market structure is also a factor. The food distribution network is dominated by informal markets, street food vendors, as well as small-scale traders. These industries are not regulated and the responsibility is not well upheld and they tend to reach most of the population. Unsafe foods are readily available since it is hard to enforce in decentralized markets. Consumers are subjected, therefore, to systemic limitations which can only be addressed through personal vigilance.

The problem is aggravated by social inequality and disparity between urban and rural populations. The city dwellers might enjoy a little more access to branded foods or supermarket chains but the rural people are dependent on traditional markets a lot. They have lesser access to educational campaigns or safe options and are exposed to more adulterated food. This poses a proportionate health hazard especially among the vulnerable groups such as children, pregnant women and the old.

Also remarkable is the psychological strain and social effect on it. Families who fall sick as a result of contaminated food usually undergo emotional stress, poor performance, and extra expenses covering treatment. Repeated exposure in the long-run will decrease trust in the food system, become health anxiety-inducing, and potentially influence community health.

To sum up, it is a multi-dimensional problem of consumer awareness in Bangladesh. Addressing it requires:

- Extensive education programs based on literacy and cultural settings,
- Assuring confirmed and safe food products at affordable costs,

- Enhancing the enforcement of regulations and participation of communities,
- The creation of unsophisticated technological detection and verification solutions, and enhancing behavioral change with the help of trust-building and awareness programs.

The vulnerability of consumers to food adulteration will prevail in Bangladesh without a comprehensive approach that will incorporate education, technology, regulation, and social involvement which will negatively affect the health, economic stability and the general living standards of the people in Bangladesh.

Chapter 4: Findings, Recommendations and Conclusion

4.1 Findings of the study

The research indicates that food adulteration is a common practice in Bangladesh where almost all the foods that people eat are adulterated. All the common foods such as rice, flour and pulse and also the perishable foods such as milk, fish, fruits and meat are all susceptible. Chemical adulteration is one of the most widespread and harmful types of adulteration. An example of this is the formalin that is commonly used in fish and fruits to make them look fresh and also synthetic colors and preservatives in sweets, street foods and milk. Physical adulteration; the addition of sand, husk, or dust of bricks into rice, pulses, spices etc., and biological adulteration; bacteria in milk and mold in stored grains are also major problems.

Such practices are dangerous to health. The short-term effects consist of nausea, vomiting, diarrhea, and food poisoning which especially affect children, the elderly and those with a weaker immune system. It is even more harmful when taken over a long period of time where liver and kidney problems develop, hormonal imbalances, cardiovascular problems and even cancer. Adulteration also impairs nutritional quality e.g. adding starch or chalk to rice and flour may influence physical and cognitive growth particularly in children.

The research also established that there is low consumer awareness hence people are more susceptible. Not everyone is aware of contaminated foods or the dangers. The economic limitations compel the low-income families to turn into informal markets, which have little or no food safety measures. The risk of being exposed is further compounded by technological constraints, mistrust in regulatory agencies and dependence on the look of food or suppliers of traditional foods.

Also, other issues of concern are the legal and ethical considerations that also come up due to food adulteration. Most of the vendors are still selling contaminated products in spite of the current food safety regulations and this speaks of the weaknesses in law enforcement and surveillance. Ethically, the sale of unsafe foods will reflect a lack of concern regarding the welfare of the consumer and the welfare of the society. The responsibility to keep food safe to consume is a

collective responsibility among the vendors, manufacturers and authorities. To deal with the situation of food adulteration, it is not only necessary to enforce the rules but also in addition, ethical standards and awareness among all the stakeholders, including customers.

Briefly, the issue of food adulteration in Bangladesh is not merely an individual issue but a severe health, socio-economic concern to the population. It influences health and nutrition and finances and must be given immediate concern.

4.2 Recommendations

The results of this paper indicate that there is no one solution to food adulteration in Bangladesh. As a matter of fact, the issue has a profound attachment to the laxity, disillusionment, and financial strain as well as to consumer protection deficiency. As such, both realistic and integrated approach is needed. Though food safety laws are already in place in Bangladesh their enforcement is still poor, especially in local and informal markets. The checks are inconsistent and, in most instances, unlawful behavior will prevail without reprisal.

- Increasing the strength of the monitoring systems and making the deliberate adulteration visible would deter such practices and allow reassuring people that regulatory bodies are effective and deserve their trust.
- Another urgent need is consumer education. Majority of the population does not eat adulterated food on a personal choice, but due to ignorance in the risks, or lack of knowledge on how to find the unsafe food. Awareness campaigns must be formulated in vernacular language and conveyed via community awareness campaigns, school and local media. In real life, knowledge as simple as knowledge on food appearance, storage and labeling can assist the consumer make safer choices.
- Food safety at consumer level could also be enhanced by technological support. In Bangladesh, currently, there is no means of food quality testing in use in the hands of ordinary households. The introduction of low-cost testing and easy reporting systems would enable the consumer to be more involved in the monitoring of food safety.

- One cannot disregard economic limitations. There are a lot of low-income families who rely on informal markets since safer options are either very costly or unavailable. The issue of relying on unsafe sources would be minimized by enhancing the supply chains and access to affordable and certified food products.
- Anonymous supply chain is one of the best methods of fighting adulteration. In Bangladesh, there is a tendency at present that when a product enters a wholesale place such as Karwan Bazar, its sources are often forgotten. The government must require a Digital Traceability Protocol of QR codes or blockchain technology on the major staples such as oils, rice, and milk. This would enable a consumer or an inspector to scan a product and view the specific farm of origin, processing plant and the distributor. The motivation to include toxic substances reduces when the accountability of a certain person or business is linked. Also, it would be possible to do so-called targeted recalls when only the contaminated batches are eliminated on the market and the innocent farmers do not lose their economies massively.
- One of the reasons why formalin is used in fish and milk is the quick spoilage by the Bangladesh tropical climate. The government should not only use police raids; it should offer tax incentives and low-interest loans to the private companies to create a nationwide system of cold-storage facilities and refrigerated transportation trucks which run on solar power. When an affordable refrigerated van is available to the fish trader in Barisal to carry his or her catch to Dhaka, the necessity to preserve permanence using formalin is automatically removed. By changing the emphasis of punishment to infrastructure-based solutions, one is solving the problem of preservation-based adulteration.
- The Bangladeshi people are heavily dependent on informal vendors who are not subjected to taxes and regulatory systems. Instead of attempting to put these vendors out of business, the state ought to establish a Graded licensing System. Basic hygiene and food safety training should be provided to the small-scale vendors in exchange of a sticker on their food with certification as a Safe Food. This will provide a market incentive; consumers will automatically be attracted to sellers who will show government approved safety qualification. This carrot-and-stick method incorporates the informal sector under the regulatory system without rampaging the income of the low-income entrepreneurs.

- Safe food is a luxury because of economic restriction. The government can fill this by coming up with a program like Safe Food Subsidy or Green Label. Direct subsidies and/or vouchers to quality seeds could be provided to farmers who raise their farms using organic fertilizers and avoiding prohibited pesticides. The market price of certified safe food would fall, as it is now made to be affordable to the farmers who are safe, this way it can be competitive with the cheaper, adulterated products in the informal markets. This renders food safety a right belonging to everybody and not an exclusive right of the rich.
- Mobile Courts though offering instant action have a limited legal scope. Bangladesh needs to introduce Specialized Food Safety Tribunals that will strictly deal with food crimes. These courts would also be manned by food chemists and forensic evidence trained judges. This would guarantee that large distributors and food mafias will be punished to the fullest degree of the law and no longer be punished with spot-fines, but with long-term jail penalties and the forfeiture of the business license. Specialized courtship also makes sure that the food safety cases do not stay behind the mountain of the rest of the pending litigations in the general court system.
- The concern of food safety is cross-border because most of the spices and fruits are imported to the country by its neighbors; India, Pakistan, or Myanmar. A South Asian Food Safety Network under the SAARC should be spearheaded by Bangladesh. This would imply live information exchange on polluted batches and prohibited chemical substances. Once a particular dye is prohibited in a certain country, the customs and food officials of any other neighboring country should instantly get to know of it. Unless regional cooperation is in place, Bangladesh will end up being a dumping ground to low-quality food products regarding quality that the rest of the international markets have rejected.
- Lastly, the healthcare sector should be more involved. Foodborne diseases are widespread, and they are hardly traced in a formal manner. Adequate documentation and monitoring over a period would assist in the identification of the risky areas and inform future policy decisions.

All in all, food adulteration should be reduced through collective efforts. Unless action is organized by regulatory bodies, consumers, healthcare institutions, and food suppliers, the issue is expected to continue even with the current legislation.

4.3 Conclusion

This paper demonstrates that food adulteration in Bangladesh is not a unique or limited issue; it is a collective and deeply reflected issue that is part of daily life. Adulteration persists in posing potential danger to health, nutrition, and general wellbeing of the population by the basic staple foods to the highly perishable products. Chemical, physical, and biological contaminants of the products that are sold as regular items show how unsafe behaviors became normalized all-around the food system.

The results also reveal that the effects of food adulteration extend well beyond immediate diseases. Although the short-term effects are mostly health related like food poisoning and gastrointestinal difficulties, there are long term effects that are severe and permanent. The burden of people, families, and the healthcare system increases due to chronic illnesses, malnutrition, and low quality of life. The effects are particularly detrimental to the vulnerable population such as children, the elderly, and low-income population.

This paper also indicates that the vulnerability of the consumer is influenced by the low awareness, economic factors, ineffective implementation of food safety standards, and unavailable methods of detection. In most instances, individuals know that food adulteration does take place but are helpless in preventing the same because of the price factors or healthier alternatives are not available. Consequently, the blame of the consumers cannot be put entirely on the consumers but has to be distributed among the institutions and stakeholders.

The use of legal frameworks is not sufficient in addressing the issue of food adulteration in Bangladesh. Tighter enforcement, realistic consumer education, accessible technological solutions

as well as consistency in health monitoring should collaborate. However, food adulteration will never stop to compromise the social-economic stability, health and the trust of the people without a concerted and sustained effort.

Finally, food safety is not only the issue related to the personal health protection but also national. Safety and quality of food are necessary to improve the health of the people, ensure that the economy is productive, and long-term development can be achieved in Bangladesh.

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