

UNDER THE MICROSCOPE

JUNE 2021

WORLD FOOD SAFETY DAY

"Safe Food Now for
a Healthy
Tomorrow"

INSIDE THIS ISSUE

FOOD SAFETY: KEY TO
SUSTAINABLE INCOME,
HEALTH AND ECONOMIC
GROWTH.

FOOD SAFETY 101 -
RECOGNISING COMMON
HAZARDS IN YOUR FOOD.

FOOD SAFETY ISSUES -
MYCOTOXINS IN FOOD
AND HUMAN CANCER RISKS



EDITOR'S DESK

Welcome to this special edition of Under the Microscope celebrating World Food Safety Day (WFSD), 2021. WFSD is an annual event held in June to draw attention to the issue of food safety.

Food is essential to life. Yet, each year, millions of people fall ill after consuming contaminated food. Despite significant advances in our understanding of hazards in foods, too many people still die from foodborne diseases. Foodborne illness describes over 200 diseases ranging from gastrointestinal infections to cancer. Food safety means ensuring that consumers are protected from any agents; biological, chemical or physical in food that causes harm.

The theme this year is 'Safe food now for a healthy tomorrow.' Safe food contributes to food security, healthy lives, and economic progress. WFSD recognises the responsibility of all actors in the food chain - producers, processors, transporters, sellers, and consumers in ensuring the food we consume is safe.

In this issue, our contributors discuss food safety issues related to the Nigerian consumer and the economy. Our goal is to draw attention to the recurring food safety challenges we face and inspire action by all stakeholders.

I end with this quote from the World Health Organisation. "If it is not safe, it is not food." Food safety is everyone's business. How are you taking responsibility?

happy reading...

amara anyagu, PhD

@amaratweets



TABLE OF contents

03

From the Lab to Society
- A Call to action

04

Food Safety 101 - What every
consumer should know

06

World Food Safety Day - Safe
food for a Healthy Tomorrow

07

Food Safety: The Key to
Sustainable Income, Health &
Economic Growth

10

Mycotoxins in food and
the risk of human cancer

12

The effect of packaging
on the safety and quality
of iru

From the Lab to Society...

Science is one of our greatest achievements as a species. Each day, we advance our understanding of the natural world. We have applied the knowledge we have gained to improve our lives and find solutions to hunger, disease, and energy needs.

Too often, scientific discovery remains within the academic community, disconnected from the wider society, who are critical stakeholders as users and funders of science. The peer-review process, when done correctly, is integral to the scientific process. However, as scientists, we must begin to take more responsibility to communicate our peer-reviewed evidence outside the academy. Science is for everyone.

"The COVID-19 pandemic has reinforced the importance of communicating science. Transparent, respectful and effective engagement is an antidote to misinformation."

- @amaratweets

Not everyone will or should be a scientist. However, everyone is impacted by the outcomes of science, for good or bad. One of the most potent lessons I learnt during the recent pandemic is that there are people who are always willing to fill information gaps. As scientists, we should be filling these gaps in the areas of our expertise.

Under the Microscope is one way I have chosen to bring my passion for microorganisms and what they do in food to people who have a passion for something else but are affected by the impacts of my research because everyone eats (insert smiley emoji)! This is a call to action to scientists everywhere, let's do our bit and stand up for science.

Amara Anyogu, PhD, is a food microbiologist fascinated with what microorganisms do in and to food. Her research interests focus on antimicrobial resistance and indigenous fermented foods. Connect with her on LinkedIn and @amaratweets. She serves as the editor for Under the Microscope.



Photo by Tope A. Asokere

FOOD SAFETY 101

What do you think of when you hear the words food safety? This article discusses common hazards in foods that we should all be aware of. To work together for safe food and good health, we need to invest in our food safety education.

Helen Onyeaka, PhD

FOOD CONTAINS NUTRIENTS THAT SUPPORT AND MAINTAIN OUR HEALTH. THESE NUTRIENTS ALSO SUPPORT THE GROWTH OF MICROBES!

Food is indispensable to the maintenance of life. It is generally accepted that we cannot survive for more than a few weeks without food. However, food can also contribute to a nation's morbidity and mortality rates via gastrointestinal diseases, allergic reactions, obesity, diabetes, and cancer.

As much as we enjoy and love eating food, it can be a vehicle by which harmful agents may be ingested. These include physical, biological or chemical agents. Physical objects include glass, jewellery, bandages, hair, and fingernails. Biological agents include microbes like bacteria, fungi and viruses. Chemical contaminants such as pesticides, toxins from biological agents, and heavy metals can also cause harm when present in our food.

Food contains nutrients that can support the growth of microorganisms. Microorganisms are everywhere and do have beneficial roles in food, for example, during fermentation to produce yoghurt, *ogi*, *garri*, etc. To keep food safe, we must ensure that disease-causing microbes are not present in food or that their growth is restricted.



The growth of certain microorganisms in food can lead to food spoilage and foodborne illnesses. Foodborne infections are caused by eating biological hazards along with food. Some common symptoms of infection are nausea, diarrhoea, abdominal pain, and fever. Food intoxication is caused by consuming food that contains a toxic chemical. These toxins are produced by microbes while growing in the food. Nausea, vomiting, and diarrhoea are the most common symptoms of food poisoning. In addition to biological agents, other hazards in food include allergens and adulterants.

Food allergies and intolerance

An allergy occurs when the body senses an ingredient in food as harmful and rapidly produces antibodies to protect itself (immune response). Some symptoms associated with food allergic reactions include vomiting, diarrhoea, skin rashes, facial swelling and breathing difficulties. In some cases, allergic reactions can be life-threatening. Food intolerance affects the digestive system, and the symptoms can take longer to manifest and are not as critical. These can include bloating, indigestion, lethargy, migraines, and rashes. The most common allergy-producing food substances are dairy products, yeast, eggs and grains, especially wheat.

Food fraud

Sometimes, food safety issues occur due to poor knowledge of good manufacturing practices and food safety knowledge of actors in food supply chains. However, hazards may also be introduced into food during fraudulent activities. Food fraud is the deliberate and intentional substitution, addition, tampering with, or misrepresentation of food ingredients, labelling, product information, or false or misleading statements made about a product for economic gain that may impact consumer health. Adulterated food is dangerous because it can be toxic and harmful to one's health and

deprive a person of nutrients necessary for proper growth and development. Food fraud can pose both economic and public health threat to consumers and, in some cases, have led to death. One of the largest food fraud incidents occurred in China in 2008. Diluted milk and infant formula were adulterated with a chemical called melamine to make it appear that there was more protein in the food products. Tens of thousands of children were hospitalised and at least six babies were confirmed to have died. Closer to home, in 2016, there were reports of "plastic rice" smuggled into Nigeria. It has also been reported that some producers in Ghana use the illegal dye, Sudan red, to enhance the colour of palm oil. The use of Sudan red as a food dye has been banned in many countries as it has been linked to cancer.

What can be done

Foodborne poisoning can be avoided if food is handled properly. The WHO guidelines for keeping food safe include maintaining good personal hygiene, separating raw and cooked food, ensuring food is cooked thoroughly, keeping food at safe temperatures, i.e. keep hot food hot and cold food cold. Finally, use safe water and materials.

Consumers need better awareness about allergens in food and fraudulent activities to make informed decisions. Proper food labelling and product declarations are also important for achieving food safety. To prevent food fraud, public authorities should be empowered to use their full regulatory powers in surveillance and enforcement. To reduce the incidence of foodborne illness in our nation, we all need to play our part. Food safety is everyone's business.

Dr Helen Onyeaka is an industrial microbiologist. Her career in microbiology spans industry, teaching and research. She works in HE and is passionate about raising awareness of food safety in Africa. Connect with her on LinkedIn and @DrOnyeaka



World Food Safety Day

SAFE FOOD NOW FOR A HEALTHY TOMORROW

1. **Ensure it is safe** - Governments must ensure safe and nutritious food for all.
2. **Grow it safe** - Agriculture and food producers need to adopt good practices.
3. **Keep it safe** - Business operators must make sure food is safe.
4. **Know what is safe** - Consumers need to learn about safe and healthy food.
5. **Team up for food safety** - Let us work together for safe food and good health.

[FAQ, WHO \(2021\)](#)

FOOD SAFETY: THE KEY TO SUSTAINABLE INCOME, HEALTH AND ECONOMIC GROWTH

YINKA SOMORIN, PHD

Food is essential to life and the safety of food is crucial to enjoying the benefits that food consumption affords. Consumption of unsafe food often leads to foodborne illnesses and the World Health Organisation has estimated that 600 million people get sick and 420,000 people die from consuming contaminated foods globally every year. Foods could be contaminated by microbiological, chemical or physical agents. Examples of microbiological contaminants are disease-causing *Escherichia coli*, *Salmonella* and *Staphylococcus aureus*. Some of these organisms cause diarrhoea, which accounts for over 9% of deaths and is the third leading cause of death in Nigeria, according to [World Health Rankings](#).

Common chemical contaminants in foods include naturally-occurring toxins such as cyanide in cassava and toxins produced by moulds known as mycotoxins; heavy metals, as well as agrochemicals such as fertilisers and pesticides. Foreign objects which are not expected in foods constitute physical contaminants and they include stones, hair, insect excrement, loose screw, plastic etc. Contamination of food could occur at any point in a product's value chain between production and consumption on-farm, through processing, transportation, storage, wholesale, retail and food preparation.

Hence, why food safety is everyone's business.

Food Safety and Regulations

Since contamination reduces the quality of food and could constitute a risk to human health, many countries have developed regulations and set up standards to minimise the presence of contaminants in food commodities available for consumption. This is particularly important because of globalization and the increasing global food trade, such that contaminated food imported from one part of the world does not threaten public health in other countries.

The European Union (EU) has very high food safety standards. This ensures that only foods of the highest quality find their way into European markets thus protecting public health. These food safety regulations could pose a significant barrier to international trade in agricultural and food products for countries depending on these commodities as a major foreign exchange earner. For example, Nigeria is a major exporter of agricultural and food products to the EU but trade in specific products has been negatively affected due to safety concerns over the years. This article focuses on three of these safety issues.

Pesticide residues in dried beans

Pesticides are often applied to beans to control insects and reduce postharvest losses during storage. However, some of the pesticides used for controlling insect pests in Nigeria are not approved for use in foods in the EU and USA, as they could cause cancers in humans and at high concentrations could lead to coma. A [study on beans](#) rejected from entering the EU, which was returned to Nigeria, showed that average levels of dichlorvos, a highly regulated pesticide in the EU, was more than 8 times the maximum allowable limit.

Furthermore, [another study on beans](#) in a Nigerian market, which was stored for 6 months after pesticide application, had almost 480 times the maximum level allowed for dichlorvos. This suggests that the problem of pesticide residues is much higher in foods consumed locally in Nigeria than those exported. Common chemical contaminants in foods include naturally-occurring toxins such as cyanide in cassava and toxins produced by moulds known as mycotoxins; heavy metals, as well as agrochemicals such as fertilisers and pesticides. Foreign objects which are not expected in foods constitute physical contaminants and they include stones, hair, insect excrement, loose screw, plastic etc. Contamination of food could occur at any point in a product's value chain between production and consumption on-farm, through processing, transportation, storage, wholesale, retail and food preparation.

Based on frequent high levels of dichlorvos in dried beans from Nigeria, more frequent inspection of beans consignment from Nigeria was put in place in 2013 and half of the consignments were tested for dichlorvos before being allowed into the EU.

Since the situation did not change, the importation of dried beans from Nigeria to the EU was banned in 2015. This ban is estimated to cost up to \$500 million in financial and job opportunities lost. Although there are [current efforts](#) to improve the safety situation of dried beans from Nigeria, the ban on beans has now been extended to June 2022 to allow the implementation of the action plan and see evidence of reduced dichlorvos levels in beans.


Aflatoxin contamination in melon seeds (egusi)

Aflatoxins are highly toxic chemicals produced mainly by *Aspergillus flavus* and *Aspergillus parasiticus*. These moulds contaminate many food crops on the field, at harvest and during storage. Aflatoxins pose a serious health threat to humans and animals as they cause liver cancers, reduced immunity and even death, hence it is important to reduce their levels in foods to as low as possible. Melon seeds are an important food product frequently contaminated by aflatoxins. In a study to investigate the levels of aflatoxins in melon seeds in local markets in [Nigeria](#) and in the [UK and Ireland](#), we found that all samples were contaminated by aflatoxins, with melon seeds collected in Nigeria having higher levels than those in the UK and Ireland.



FOOD SAFETY

THE KEY TO SUSTAINABLE INCOME, HEALTH AND ECONOMIC GROWTH



Based on high levels and frequency of aflatoxin contamination in melon seeds, the EU increased the frequency of checks on melon seed consignments from Nigeria in 2013, a procedure that is still in place.

Salmonella contamination in sesame seeds

Sesame is an important crop in Nigeria and sesame seeds was the most important non-oil export product in Nigeria in three quarters in 2020, according to the Nigerian Bureau of Statistics. Foreign trade in sesame seeds is being negatively impacted due to import restrictions caused by food safety concerns, particularly contamination with *Salmonella*.

While it is unclear at what stage *Salmonella* contaminates sesame seeds, it is likely to be during the heaping of the harvested steps on the farm when drying and shattering of the capsules on the ground. There is limited information on *Salmonella* contamination in sesame available for retail sale.

In a study we conducted recently, we showed that the levels of rejection of sesame seeds due to *Salmonella* contamination by the EU have increased drastically in the last 5 years. In light of the theme of the World Food Safety Day (WFSD) 2021, “Safe food now for a healthy tomorrow”, there is an urgent need to focus on improving the safety and quality of foods meant for local consumption and export from Nigeria.

For example, addressing *Salmonella* contamination in the sesame value chain will expand the sesame seeds market, promote global trade and help in building a resilient post-COVID Nigerian economy. It is important to research and implement good agricultural, hygienic and storage practices at all stages in food value chains in order to guarantee sustained livelihoods of smallholder farmers (SDG 1), provide safe food (SDG 2), protect human health (SDG 3) and grow the economy (SDG 8).

Yinka Somorin, PhD, is a motivated early career scientist with a strong passion for excellence in academic research, teaching and developing human capacity. Connect with him on LinkedIn and @micro_YMS

FOOD SAFETY ISSUES

MYCOTOXINS IN FOOD AND THE RISK OF HUMAN CANCER

PATIENCE T. FOWOYO, PHD

In the course of our lives, we may have taken care of or even lost a loved one to cancer. Writing this brings a rush of adrenaline as I relive the memories and pain from losing a distant cousin who died of cancer. The question on the lips of everyone was how she could have had cancer, considering that she took her health very seriously. Their questions ranged from could the basis of her cancer be genetic? Nutritional? Lack of exercise? On and on, the list went.

Cancer refers to many disease conditions that arise when normal body cells do not die at the end of their life cycle but rather begin to divide uncontrollably (making more of themselves), then aggregate together and grow into a lump or tumour, which may spread and destroy other body tissues, if malignant. Several risk factors predispose individuals to cancer, such as smoking, drinking too much alcohol, diet (not eating right), physical inactivity, overweight, family history (genes), chemical substances in the food and environment.

Research into the links between the food we eat and cancer has been going on for decades. Certain substances in food can accumulate over time in body cells and tissues. These may promote the proliferation of body cells, resulting in tumour formation and ultimately becoming cancerous.



Consumption of processed and red meats, alcohol, and high-calorie foods are usual suspects when cancer risks and diet are being discussed. However, a less well-known substance in food that can accumulate in the body over time and associated with cancer is a group of chemicals called mycotoxins.

Mycotoxins are naturally occurring toxins produced by some microscopic fungi (moulds) present in food. The typical foods in which mycotoxins have been found include maize, cereals, groundnuts and tree nuts. The fungi producing these mycotoxins can grow on various crops and foodstuff and penetrate deep into the food and not just the surface. Removing visible mould from the surface of food products does not guarantee it to be free of mycotoxins.

Mycotoxin producing fungi thrive well in warm and humid environments. If these food products are improperly stored before or after harvest and storage, mould can take advantage to proliferate and liberate their toxins into food. There are different types of mycotoxins, but the most common are ochratoxin, fumonisin and aflatoxin. Mycotoxins are easily absorbed via dietary consumption in contaminated food or via the respiratory system when inhaled. They can then be distributed around the body via the circulatory system.

Mycotoxins can penetrate the cell membrane, attach to DNA and alter the genetic information (mutation). Some of these mutations can lead to cancer. The World Health Organisation's International Agency for Research on Cancer (IARC) has recognised a mycotoxin called aflatoxin B1 (AFB1) as a cancer-causing substance (carcinogen). Several scientific studies have investigated the link between mycotoxin exposure and the risk of developing different cancers.

Mycotoxins exposure in the diet has been associated with increased risk for liver and oesophageal cancer in humans. It is important to note that much of our knowledge on mycotoxins and cancer risk comes from experimental studies using animals. In a recent [scientific paper](#) reviewing the research conducted on this topic, the authors concluded that to understand the link between mycotoxin and cancers better, more data from epidemiologic studies, i.e. from populations more likely to be exposed to mycotoxins, is required.

To safeguard human health, reducing exposure to mycotoxins in food is paramount. Mycotoxin producing fungi do not grow well when food is stored well in dry and clean conditions. Advice from the WHO to consumers include inspecting whole grains and nuts before purchasing. Signs to look for are mould, discolouration or shrivelling. Also, ensuring that grains and nuts are not damaged or broken and fresh as much as possible. Maize, cereals and nuts are important staples in the African diet. Contamination may lead to chronic, high-level exposure. Consuming a diverse diet that includes other food groups reduces this risk.

More work remains to raise awareness of mycotoxins among food producers, processors, and consumers. Also, providing adequate storage and obtaining epidemiological data on mycotoxin exposure among the Nigerian populace will go a long way in safeguarding public health.

Patience T. Fowoyo, PhD, is an Associate Professor of Food Microbiology. Her work focuses on elucidating the role of microorganisms in food safety, security, preservation and improved food processing. She is a member of both local and international microbiological societies and was recently nominated as a member of the prestigious society, Sigma Xi.



THE EFFECT OF PACKAGING ON THE QUALITY OF IRU

An important first step in improving food safety in Nigeria is to understand the nature of the hazards that exist in our foods and identify effective intervention strategies.

Afolake Olanbiwoninu, PhD

HAZARDS IN FOOD ARE LINKED TO 137,000 DEATHS AND 91 MILLION ILLNESSES EACH YEAR IN AFRICA. CHILDREN UNDER 5 ARE THE MOST AFFECTED.

Iru is the fermented product of the seeds of the locust bean plant. It is a popular condiment in Nigeria and many nations of Central and West Africa. It is used as a flavour enhancer, like Maggi cubes with the advantage of ingesting energy, vitamins and protein. Iru production is mainly on a small scale household basis, by processor-sellers. This industry is an important source of income, contributing to sustainable development via income generation and gender equality.

Raw locust beans are boiled and soaked in water to soften seed coats before removal. The seeds are cooked for a few hours and placed in calabashes, covered with wooden trays and wrapped in jute bags. This provides a warm environment for the fermentation process which usually lasts for about 4 days.


This traditional process for iru production is based on spontaneous fermentation processing. It relies on the natural bacteria present in the locust beans and chance inoculation from the environment. The dominant bacterial species in iru are *Bacillus*.





THE EFFECT OF PACKAGING

ON THE MICROBIOLOGICAL QUALITY OF IRU



After fermentation, 'iru' are wrapped in banana leaves for storage, transportation and selling. These thick glossy leaves retain moisture and do not degrade easily. It is also believed that banana leaves impart flavour to iru. Leaves only have limited protection against impact injury and preventing contamination of the food product packed in them.

Recently, the packaging of iru is done in plastic bags and containers. An advantage of plastic packaging (PP) is its durability, as leaves eventually spoil. Most PP is transparent, allowing the product placed inside to be seen. Product distribution is more convenient, as PP can be produced in different sizes and are lightweight. However, most PP, especially nylon bags, do not provide sufficient protection against water, vapour and gas. There is limited infrastructure for recycling PP in Nigeria. Besides, most of the PP used for iru are single-use plastics. There is increasing concern about plastic pollution and, more specifically, its impact on marine life.

We were curious about the effect of packaging (leaves or PP) on the safety and quality of iru and decided to take this into the lab. Our aim was to identify the microorganisms present in iru and how this was influenced by the packaging used. 'Iru' was prepared using the traditional method in the Food Microbiology Laboratory of Ajayi Crowther University, Oyo State, Nigeria. Iru was packed in leaves, plastics and polyethylene (nylon) containers and placed in the sun to simulate normal market conditions. Microbiological analyses were carried out at different time intervals of 0, 24 and 48 h.

Interestingly, iru packaged in banana leaves showed the best microbiological quality as no disease-causing microorganisms (pathogens) were identified. However, potentially pathogenic bacteria were isolated at concerning levels from PP iru. The high number of these organisms indicates the unwholesomeness of the fermented condiments, resulting in an increased risk of transmission of foodborne illness to consumers.

Our results suggest that iru consumers could buy their 'iru' packaged in leaves and then transfer them to plastic containers at home and store these appropriately rather than buy iru packed in plastic and polyethylene that may have been exposed to the sun for days. There is a need for further studies. This would involve using more samples collected from different producers/sellers and at different processing stages. In addition, DNA based techniques should be used to identify the bacteria present in iru and similar products.

Most harmful bacteria we found in iru can be destroyed with adequate cooking. However, some pathogens produce toxins in food, and even though the organisms are killed, the food may still be unsafe. There is little to no surveillance in Nigeria and, consequently, data on food-borne disease deaths and illnesses attributed to unidentified pathogenic agents in the food supply.

Dr Afolake Olanbiwoninu is a microbiologist with extensive experience in research and teaching. Her research interests include the enrichment of fermented foods using organisms that have the ability to produce specific vitamins to alleviate malnourishment within the society.



KEEP FOOD SAFE!

01. KEEP CLEAN

Microbes that cause disease can be found in soil, water, animals and our faeces. Ensuring we keep clean by washing our hands regularly and cleaning utensils thoroughly keeps our food safe.

02. SEPARATE RAW AND COOKED

The juices in raw food such as meat and poultry can contain harmful microbes. As much as possible, keep these foods separate during food preparation and storage. When washing uncooked chicken, ensure that the area you are working in is cleaned properly with soap or sanitiser before working with cooked food in the same area. Use separate utensils, e.g. chopping boards for your salads and meat, chicken, fish.

03. COOK PROPERLY

Most dangerous microorganisms that are present in food can be killed if the food is cooked properly. It is also important that food is reheated properly, i.e. hot throughout. Animal-based protein such as chicken, seafood and meat can be particularly vulnerable.

04. KEEP FOOD AT SAFE TEMPERATURES

Like other living organisms, microbes require food, water, warmth and time to grow. Unlike other organisms, microbes can grow (multiply) very quickly. Under the right conditions, some microbial cells can divide every 30 minutes and reach unacceptable levels in food within hours. At low temperatures, microbial growth slows down and at higher temperatures (above 70 degrees celsius) microbes can be killed. A simple rule of thumb is 'keep hot food hot and cold food cold.'

05. USE SAFE WATER AND RAW MATERIALS

Safe water does not contain dangerous microorganisms or toxins. Water should be treated to ensure it is safe. Do not consume foods after the 'use-by' or expiry date. Wash fruits and vegetables properly, especially if consuming raw. Inspect food for bruising and damage and throw away or cut out before consuming.

Adapted from the World Health Organisation's [Five Keys to Safer Food](#) manual. A 4-minute video summary is also available [here](#).

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Food safety must remain at the centre of all thinking and action towards achieving the goal of Zero Hunger.

@AMARATWEETS

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Too many people still fall ill or die each year after consuming unsafe food. A significant number within this group reside in Africa. To change this, action is required by all stakeholders. First, as producers, sellers, handlers, transporters, policymakers, regulators and consumers, we must recognise our responsibility to ensure safe food. We must invest in our food safety education and do the right thing...every single time. Safe food means health and wealth. Next, we must build capacity to develop evidence-based food systems built on good quality data. Co-operation and communication are vital in achieving this laudable goal.

Thank you for reading.

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