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Innovative Processing Technologies for Challenging Food Products

Presented by:
Brendan Niemira, USDA-ARS
Alvin Lee, IIT-IFSH
Larry Keener, IPSC
Purnendu Vasavada, UW-River Falls

Agenda

- Innovation in processing technologies
- Emerging pathogens and issues
- Challenging food matrices
- Roundtable Discussion and Q&A
- Wrap-up

Energy-based nonthermal interventions

Brendan A. Niemira, PhD

USDA-ARS

Wyndmoor, PA

Nonthermal antimicrobial interventions: not enough time to talk about them all!

- Radiofrequency energy
- Monochromatic light (405nm)
- Pulsed electric field
- Ultrasound
- **Cold plasma**
- **Pulsed light**
- UV
- High pressure processing
- Oscillating magnetic fields
- Ozone
- Chlorine dioxide
- Antimicrobial packaging

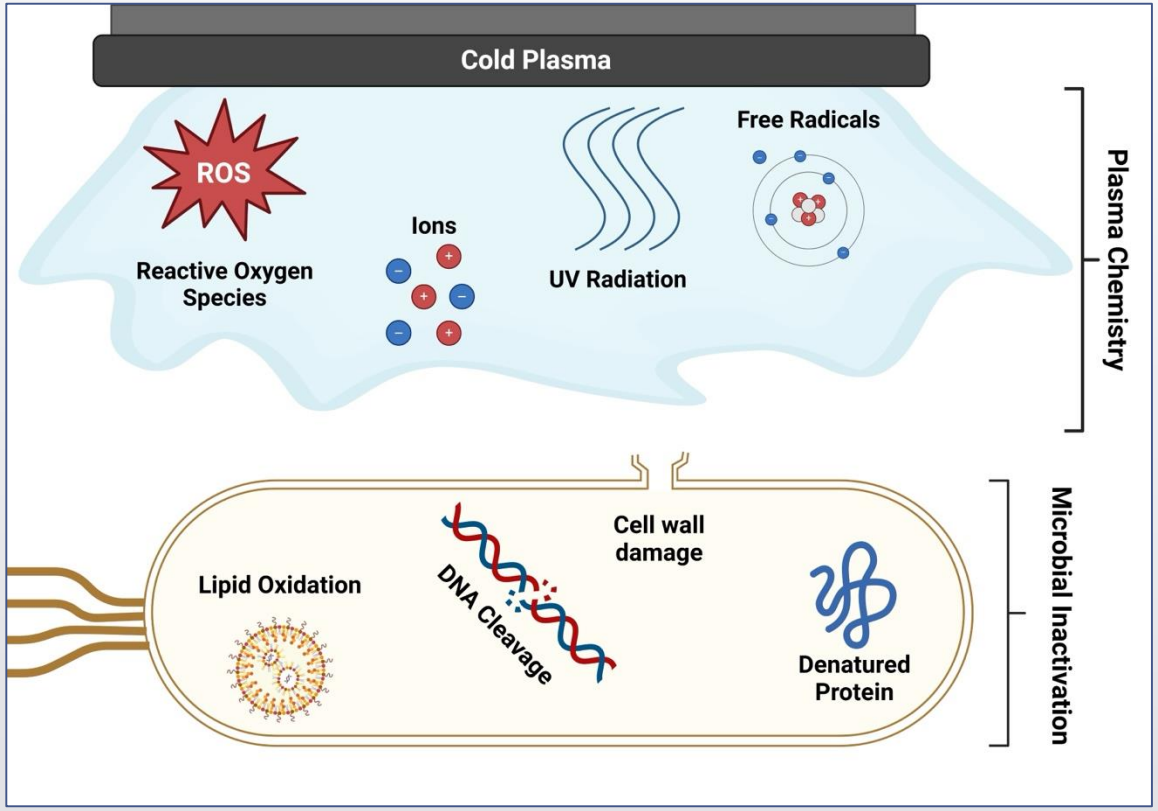
Cold plasma

- Ionized plasma created by energetic breakage of gas and/or liquid molecules.
  - Typically uses high-voltage electricity, but sometimes microwaves or laser
- Generated plasma is near room temperature. Nonthermal process.
- Antimicrobial modes of action from reactive plasma species: free electrons, ions, reactive oxygen or nitrogen species
- Can be waterless (plasma jet, DBD, corona discharge)
- Cold plasma products captured in solution = plasma-activated water
- Not yet FDA-approved

Cold plasma

- Multi-log inactivation of pathogenic bacteria, viruses, parasites, including spoilage organisms and plant pathogens
- Broadly effective: fresh and fresh-cut fruits and vegetables, meats and poultry, cheese, low moisture foods, food contact surfaces
- Waterless cold plasma is surface decontamination – limited penetration
- Plasma-activated water functions as a sanitizer solution. Generated on-demand, on-site
- Inputs are air, water, electricity. No residues, no chlorine, no acids.

Cold plasma


Cold Plasma
ROS
Reactive Oxygen Species
Ions
UV Radiation
Free Radicals
Plasma Chemistry
Lipid Oxidation
DNA Cleavage
Cell wall damage
Denatured Protein
Microbial Inactivation

Pulsed light

- Broad spectrum white light, delivered in short, intense pulses
- Wavelength ranges from 180 to 1100 nm, with 40% of the energy being in the UV region
- Surface decontamination effects
- Effective against bacterial and viral pathogens, spores, spoilage microorganisms (yeasts and molds)
- Primary mode of action is from UV disruption of pathogen cells
- FDA-approved

Pulsed light

- Multi-log inactivation on a variety of commodities
  - *E. coli* (1.4 - 3.03 log), *L. innocua* (0.9 – 2.66 log)
  - Spinach, tomato, mushroom, endive
- Combination of pulsed light with other interventions holds great promise for synergy
- *E. coli* O157:H7 on Romaine lettuce
- Pulsed light (10.5 J/cm^2): **2.3 log**. Nisin-based wash (2'): **2.2 log**. Combo: **>5 log** (Mukhopadhyay et al, 2024, Food Micro)
- Pulsed light (31.5 J/cm^2): **2.7 log**. Cold plasma (45s): **2.1 log**. Combo: **>5 log** (Mukhopadhyay et al, 2024, J Food Safety)

Raw Diet Pet Food

Journal of Food Protection 86 (2023) 100124

Contents lists available at ScienceDirect

Journal of Food Protection

journal homepage: www.elsevier.com/locate/jfp

Research Paper

Inactivation of *Salmonella*, Shiga Toxin-producing *E. coli*, and *Listeria monocytogenes* in Raw Diet Pet Foods Using High-Pressure Processing

Alvin Lee [1], Nicole Maks-Warren [1], Viviana Aguilar [1], Karolina Piszczor [1], Brittany Swicegood [1], Mu Ye [1], Joshua Warren [1], Edward O'Neill [2,*], Mark Fleck [3], Susy Tejayadi [4]

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ARTICLE INFO

Keywords:
High-pressure processing
Listeria monocytogenes
Pathogen reduction
Raw diet pet foods
Salmonella
Shiga Toxin-producing *E. coli*

ABSTRACT

Pet food formulated with raw meat can pose health risks to pets and humans. High-pressure processing (HPP) was evaluated to achieve a 5-log reduction of *Salmonella*, *E. coli* STEC, and *L. monocytogenes* in commercial raw pet foods and maintain a 5-log reduction throughout post-HPP storage. Three formulation types that varied in the amounts of striated meat, organ meat, bone, seeds, and other ingredients (fruits, vegetables, and minor ingredients) designated as A-, S-, and R-formulations were used.

Eight raw diet pet foods, consisting of three beef formulations (A-, S- and R-Beef), three chicken formulations (A-, S-, and R-Chicken), and two lamb formulations (A- and S-Lamb), were inoculated with 7 log CFU/g cocktails of *Salmonella*, *E. coli* STEC or *L. monocytogenes*, HPP at 586 MPa for 1–4 min, and stored refrigerated (4°C) or frozen (−10 to −18°C) for 21 days with microbiological analyses at various time intervals.

A- formulations (20–46% meat, 42–68% organs, 0.9–1.3% seeds, and 10.7–11.1% fruits, vegetables, and minor ingredients) inoculated with *Salmonella* and treated at 586 MPa for at least 2 min achieved a 5-log reduction 1 day post-HPP and maintained that inactivation level during frozen storage. A- and S-formulations inoculated with *E. coli* STEC and treated at 586 MPa for at least 2 min achieved a 5-log reduction from day 6 of frozen storage.

L. monocytogenes was more HPP resistant than *Salmonella* and *E. coli* STEC. S-formulations containing chicken or beef and stored frozen post-HPP had lower inactivation of *L. monocytogenes* compared to A-formulations containing chicken or beef. S-Lamb had higher frozen storage inactivation (5.95 ± 0.20 log CFU/g) compared to chicken (2.52 ± 0.38 log CFU/g) or beef (2.36 ± 0.48 log CFU/g). HPP coupled with frozen storage time was effective in achieving and maintaining a 5-log reduction of *Salmonella* and *E. coli* STEC while *L. monocytogenes* was more resistant and requires further optimization to achieve a 5-log reduction.

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journal homepage: www.elsevier.com/locate/jfp

Research Paper

The Combined Use of High Pressure Processing and Lactic Acid Containing Fermentate on Inactivation of *Salmonella*, Shiga Toxin-producing *E. coli*, and *Listeria monocytogenes* in Raw Pet Foods

Alvin Lee [1], Nicole Maks-Warren [1], Viviana Aguilar [1], Brittany Swicegood [1], Lindsay Halik [1], Joshua Warren [1], Edward O'Neill [2,*], Jason Meents [3], Susy Tejayadi [4]

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ARTICLE INFO

Keywords:
High pressure processing
Lactic acid
Listeria monocytogenes
Pathogen reduction
Raw diet petfood
Salmonella
Shiga Toxin-producing *E. coli*

ABSTRACT

Raw meat pet foods can pose health risks to pets and humans. High-pressure processing (HPP) was used in a previous study to demonstrate its effectiveness in achieving a 5-log reduction of *Salmonella*, *E. coli* STEC, and *L. monocytogenes* in commercially available raw pet foods and maintaining the 5-log reduction throughout shelf-life with frozen storage being more effective than refrigerated. *L. monocytogenes*, being more HPP resistant, could potentially regrow when stored at refrigeration temperatures and required further optimization. Chicken-based raw diet pet food was inoculated with 7–8 log CFU/g cocktails of *Salmonella* spp., *E. coli* STEC, or *L. monocytogenes* and stored at 4 °C for 24 h before the addition of either 0.7% or 1.0% w/v lactic acid fermentate (LAF) and HPP treated at 586 MPa for 2, 3, and 4 min after 24 or 72 h storage at 4 °C. HPP-treated products were stored frozen (−10 to −16 °C) up to 21 days with microbiological analyses on days 1, 3, 5, 7, 14, and 21. All HPP-and LAF-treated samples demonstrated a 5-log reduction of *Salmonella* spp., *E. coli* STEC, and *L. monocytogenes*. Samples without LAF and HPP treated after 24 h storage at 4 °C resulted in an average 4.02 log cfu/g reduction of *L. monocytogenes* with 2 min HPP hold time while longer HPP hold times at 4 min improved *L. monocytogenes* reduction by 0.35 log cfu/g. *E. coli* was found to be more HPP resistant in this study than *L. monocytogenes* and the addition of LAF had a significant impact on the overall pathogen survival during post-HPP storage. Based on qualitative enrichment data for each pathogen, the use of LAF resulted in more complete inactivation compared to samples without LAF. The use of 1% LAF in combination with 586 MPa for 4 min was found to be most effective for the inactivation of *Salmonella* spp., *E. coli* STEC, and *L. monocytogenes*. The findings are significant as it provides both formulation and processing controls to ensure the safety of raw diet pet foods.

HPP + Lactic Acid

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Updates on Highly Pathogenic Avian Influenza (HPAI)

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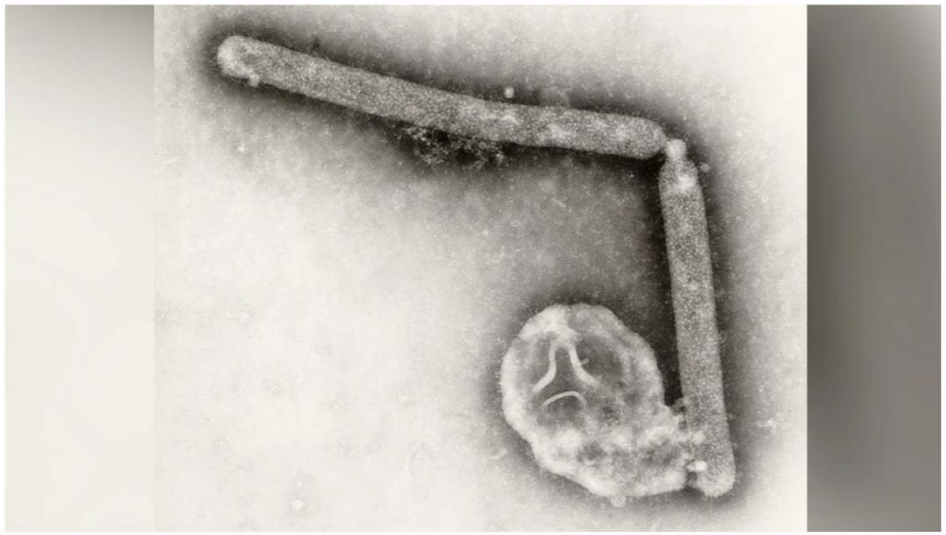
What a US farmworker's case of bird flu tells us about tracking the infection

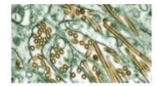
By Brenda Goodman, CNN

4 minute read · Published 10:31 AM EDT, Fri May 3, 2024



A dairy worker's infection is important because it confirms that humans can be infected with H5N1 after

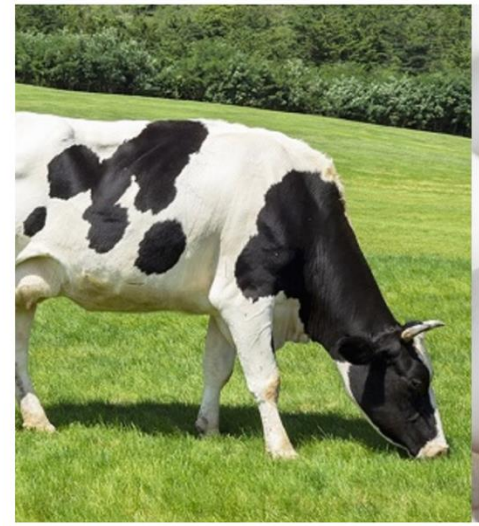
MORE FROM CNN



H5N1 bird flu was circulating in dairy cows for four months before it ...

Continued FDA testing finds no active bird flu virus in variety of dairy ...

USDA says it is testing beef for H5N1 bird flu virus



Fragments of bird flu virus genome found

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FDA says

The test cannot tell if the virus is live. The FDA still assess milk supply as safe.

BETH MOLE - 4/23/2024, 8:20 PM

USDA Animal and Plant Health Inspection Service
U.S. DEPARTMENT OF AGRICULTURE

Detection of Highly Pathogenic Avian Influenza (H5N1) in Dairy Herds: Frequently Asked Questions

Updated April 16, 2024

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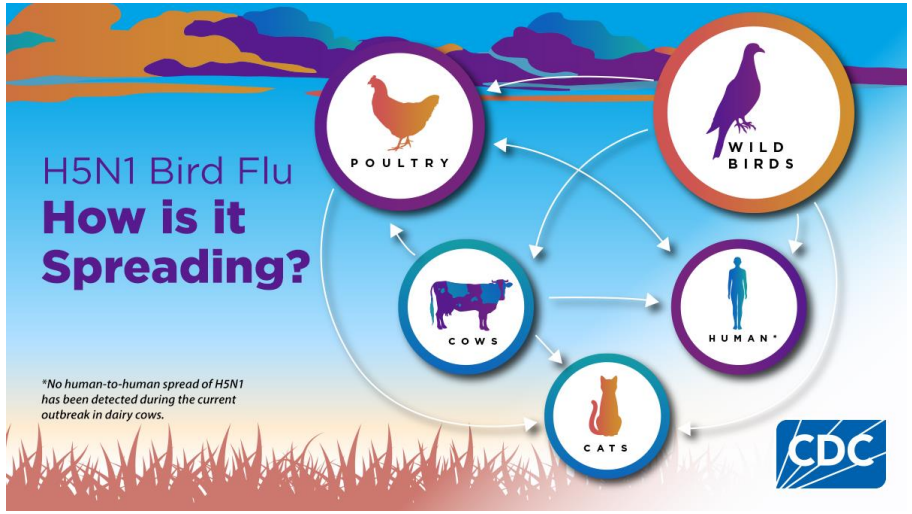
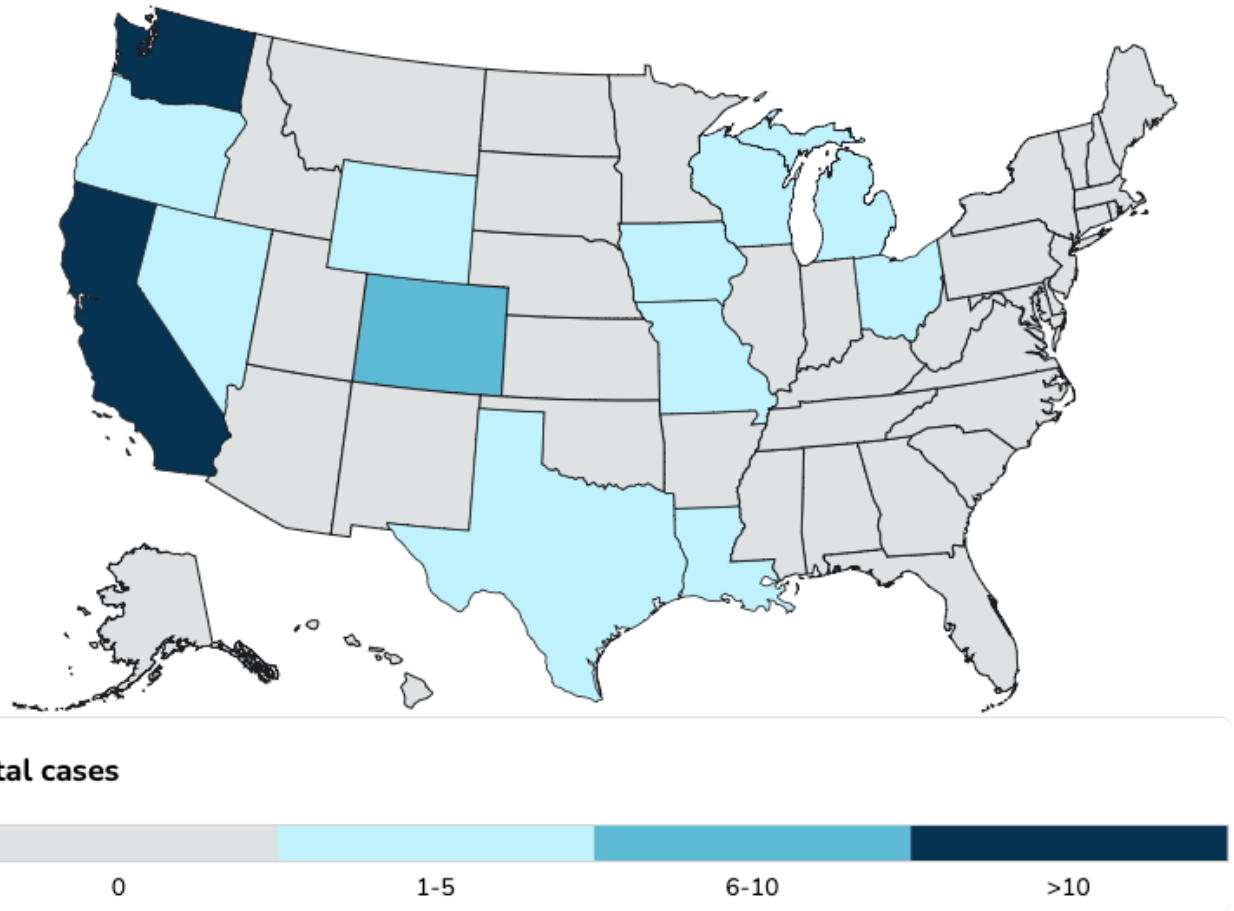
H5 Current Situation

National situation summary

Person-to-person spread	Current public health risk
NONE — There is no known person-to-person spread at this time.	LOW — The current public health risk is Low.

Cases in the U.S.	Deaths in U.S.
70 cases	1 death





www.cdc.gov/bird-flu/situation-summary/index.html?cove-tab=0

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Research Paper

Inactivation of Highly Pathogenic Avian Influenza Virus with High-temperature Short Time Continuous Flow Pasteurization and Virus Detection in Bulk Milk Tanks

Erica Spackman [1,*,†], Nathan Anderson [2], Stephen Walker [2,*,‡], David L. Suarez [1], Deana R. Jones [3], Amber McCoig [4], Tristan Colonius [4], Timothy Roddy [5], Nicholas J. Chaplinski [3]

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ARTICLE INFO

Keywords:
Influenza A
Influenza cows
Raw milk
Viruses pasteurized milk

ABSTRACT

Infections of dairy cattle with clade 2.3.4.4b H5N1 highly pathogenic avian influenza virus (HPAIV) were reported in March 2024 in the U.S. and viable virus was detected at high levels in raw milk from infected cows. This study aimed to determine the potential quantities of infectious HPAIV in raw milk in affected states where herds were confirmed positive by USDA for HPAIV (and therefore were not representative of the entire population), and to confirm that the commonly used continuous flow pasteurization using the FDA approved 72 °C (161°F) for 15 s conditions for high−temperature short time (HTST) processing, will inactivate the virus. Double-blinded raw milk samples from bulk storage tanks from farms (n = 275) were collected in four affected states. Samples were screened for influenza A using quantitative real-time RT-PCR (qrRT-PCR) of which 158 (57.5%) were positive and were subsequently quantified in embryonating chicken eggs. Thirty-nine qrRT-PCR positive samples (24.8%) were positive for infectious virus with a median titer of 3.5 $\log_{10}$ 50% egg infectious doses (EID_{50}) per mL. To closely simulate commercial milk pasteurization processing systems, a pilot-scale continuous flow pasteurizer was used to evaluate HPAIV inactivation in artificially contaminated raw milk using the most common legal conditions in the US: 72 °C (161°F) for 15 s. Among all replicates at two flow rates (n = 5 at 0.5 L/min; n = 4 at 1 L/min), no viable virus was detected. A mean reduction of ≥5.8 ± 0.2 $\log_{10}$ EID_{50}/mL occurred during the heating phase where the milk is brought to 72.5 °C before the holding tube. Estimates from heat-transfer analysis support that standard U.S. continuous flow HTST pasteurization parameters will inactivate >12 $\log_{10}$ EID_{50}/mL of HPAIV, which is ~9 $\log_{10}$ EID_{50}/mL greater than the median quantity of infectious virus detected in raw milk from bulk storage tank samples. These findings demonstrate that the US milk supply is safe when pasteurized.

Hepatitis E Virus

Food and Environmental Virology (2023) 15:246–254
https://doi.org/10.1007/s12560-023-09561-4

RESEARCH

Detection of Hepatitis A RNA, Hepatitis E RNA, Human Adenovirus F DNA, and Norovirus RNA in Fresh and Frozen Berry Products at Point of Retail in Ireland

Charlene Bennett[1] · Kevin Hunt[2] · Francis Butler[2] · Sinead Keaveney[3] · Séamus Fanning[4] · Cillian De Gascun[1] · Suzie Coughlan[1] · Joanne O'Gorman[1]

Received: 2 May 2023 / Accepted: 22 July 2023 / Published online: 1 August 2023

Abstract
Soft fruits are at particular risk of contamination with enteric viruses such as Hepatitis A virus (HAV), Hepatitis E Virus (HEV), Norovirus (NoV), Human Adenovirus (HAdV) and Sapovirus (SaV). The aim of this study was to investigate, for the first time, the presence of these biological agents in ready to eat (RTE) berries at point of retail in Ireland. A sampling strategy was designed in which RTE fresh and frozen strawberries and raspberries were purchased from five retailers between May and October 2018. Reverse Transcriptase Polymerase Chain Reaction (RT-qPCR) assays for HEV RNA, Nov RNA, SaV RNA, and human Adenovirus species F DNA (HAdV-F) were performed on 239 samples (25g portions). Viral nucleic acid was present in 6.7% ($n=16$) of samples tested as follows: HAV RNA ($n=5$), HAdV-F DNA ($n=5$), HEV RNA ($n=3$) and NoV GII RNA ($n=3$). Sapovirus RNA was not detected in any product. No significant differences were found between berry type, fresh/frozen status, or supermarket source. This study suggests a risk that exists across all retail outlets however only low levels of nucleic acid ranging from 0 to 16 genome copies/g were present. Although these findings may reflect non-viable/non-infectious virus the continued provision of risk mitigation advice to consumers is warranted and further work is required to ensure control measures to reduce contamination are implemented and enforced.

viruses

MDPI

Review

Hepatitis A Virus and Hepatitis E Virus as Food- and Waterborne Pathogens—Transmission Routes and Methods for Detection in Food

Katalin Nemes *, Sofia Persson and Magnus Simonsson

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Abstract: Foodborne viruses are an important threat to food safety and public health. Globally, there are approximately 5 million cases of acute viral hepatitis due to hepatitis A virus (HAV) and hepatitis E virus (HEV) every year. HAV is responsible for numerous food-related viral outbreaks worldwide, while HEV is an emerging pathogen with a global health burden. The reported HEV cases in Europe have increased tenfold in the last 20 years due to its zoonotic transmission through the consumption of infected meat or meat products. HEV is considered the most common cause of acute viral hepatitis worldwide currently. This review focuses on the latest findings on the foodborne transmission routes of HAV and HEV and the methods for their detection in different food matrices.

Keywords: hepatitis A virus; hepatitis E virus; foodborne transmission; viral detection; RNA; detection in food; foodborne outbreak; foodborne disease; bivalve molluscan shellfish (BMS)

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Campylobacter spp in New Homes

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Research Paper

Campylobacter jejuni Outbreak Linked to Raw Oysters in Rhode Island, 2021

Genevieve Caron [a], Brendalee Viveiros [b,*], Christopher Slaten [b], David Borkman [c], Adam Miller [d], Richard C. Huard [d]

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ARTICLE INFO

Keywords:
Aquaculture Farms
Bird Abatement
Campylobacter Contamination
Environmental Assessment
Foodborne Illness Outbreak
Shellfish

ABSTRACT

Oysters and other shellfish are not a food that is commonly highlighted as high risk for *Campylobacter* contamination. The Rhode Island Department of Health (RIDOH) conducted a multiagency investigation of a *Campylobacter jejuni* outbreak that was linked to the consumption of raw oysters; the first such outbreak was detected in Rhode Island. The environmental investigation identified birds as the likely source of contamination of the aquacultured oysters. As a result of this outbreak response, several investigative processes and best practice recommendations are offered. 1) RIDOH will be including exposure to raw shellfish as a question on their case report forms to better identify future oyster-related *Campylobacter* clusters. 2) It is important that shellfish aquaculture farms be aware of the risks of using floating gear to hold oyster cages and of the importance of using bird abatement to keep birds off floating aquaculture gear to prevent contamination of oysters from bird feces. 3) It should be recognized that fecal coliform water samples collected near an oyster aquaculture farm may not act as an adequate indicator for the presence of *Campylobacter*. 4) For the first time, Rhode Island has developed guidelines for the closure and reopening of oyster harvest areas due to contamination with *Campylobacter*. It is hoped that increased awareness and mitigation of the described risk factors will help prevent future similar outbreaks of illness.

AMERICAN SOCIETY FOR MICROBIOLOGY | Microbiology Resource Announcements

GENOME SEQUENCES
November 2024 Volume 13 Issue 11 e00810-24
https://doi.org/10.1128/mra.00810-24

Complete genome sequence of a potential new species *Vibrio* sp. NTOU-M3 isolated from hard clam, *Meretrix taiwanica,* in Taiwan

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Vibrio sp. NTOU-*M3* is a potential new bacterium isolated from hard clam (*Meretrix taiwanica*) in the estuarine region of Taiwan. The complete sequences obtained using Oxford Nanopore Technologies and Illumina sequencing consist of a 3,272,438-bp large circular chromosome and a 1,584,497-bp small circular chromosome.

KEYWORDS *Vibrio*, hard clam, *Meretrix taiwanica*, Oxford Nanopore Technologies

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Vibrio bacteria in seafood: increased risk due to climate change and antimicrobial resistance

Published: 23 July 2024 | 4 minutes read

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The *prevalence* of *Vibrio* in seafood is expected to increase both globally and in Europe because of climate change, especially in low-salinity or brackish waters, according to EFSA's latest assessment. Additionally, resistance to last-resort antibiotics is increasingly found in some *Vibrio* *species* .

EFSA's scientists have carried out an assessment of the public health aspects of *Vibrio* spp. related to the consumption of seafood. *Vibrios* are aquatic bacteria that can be found in seafood. Some strains are pathogenic and can cause gastroenteritis or severe infections. In a previous report (CLEFSA), EFSA's experts analysed the possible effects climate change could have on a wide range of food safety-related issues, including *Vibrio* bacteria in seafood.

pathogens MDPI

Article

First Data on *Campylobacter* spp. Presence in Shellfish in Croatia

Luka Jurinović [1], Biljana Ječmenica [1], Natalija Džafić [2], Diana Brlek Gorski [3], Borka Šimpraga [1], Fani Krstulović [1], Tajana Amšel Zelenika [1] and Andrea Humski [4,*]

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3 Croatian Institute of Public Health, Rockefeller Str. 7, 10000 Zagreb, Croatia
4 Croatian Veterinary Institute, Savska Str. 143, 10000 Zagreb, Croatia
* Correspondence: humski@veinst.hr

Abstract: This study aimed to assess the presence of thermotolerant *Campylobacter* spp., as one of the most important foodborne zoonotic pathogens, in three shellfish species: mussels (*Mytilus galloprovincialis*), oysters (*Ostrea edulis*) and queen scallops (*Aequipecten opercularis*). The samples were collected from nine locations in the Istrian aquatory, Croatia. Isolation of *Campylobacter* was done according to standard ISO method, and species were identified using multiplex PCR. Isolates identified as *C. jejuni* and *C. lari* were genotyped using multilocus sequence typing (MLST) to determine the potential source of contamination. Among 108 examined samples of bivalve molluscs, mussels dominated and were the only ones found positive for the presence of *Campylobacter* (25.6%). In total, 19 *C. lari* and 1 *C. jejuni* strains were isolated. *C. lari* isolates found in this study belong to 13 sequence types (STs), and 9 of them are newly described in this paper. Two out of the four previously described *C. lari* STs that were found in this study were previously found in human stool. The only *C. jejuni* isolate was found to be sequence type 1268, which belongs to ST-1275 clonal complex that is almost exclusively found in seabirds and can sporadically cause infection in humans. Regarding the obtained results, introducing surveillance of thermotolerant *Campylobacter* in shellfish in the Republic of Croatia is advised as an improvement for public health safety.

Keywords: *Campylobacter jejuni; Campylobacter lari;* bivalve molluscs; MLST

check for updates

Citation: Jurinović, L.; Ječmenica, B.; Džafić, N.; Brlek Gorski, D.; Šimpraga, B.; Krstulović, F.; Amšel Zelenika, T.; Humski, A. First Data on *Campylobacter* spp. Presence in Shellfish in Croatia. *Pathogens* **2022**, *11*, 943. https://doi.org/10.3390/pathogens11080943

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Other Challenging Matrices

Cronobacter Outbreak Linked to Powdered Infant Formula

INVESTIGATION NOTICE

Investigation start date: February 17, 2022
Investigation status: Closed
Recall issued: Yes
CDC's investigation is closed. No additional cases have been identified as part of this investigation.

Fast Facts

United States

- Cases: 4
- Confirmed cases: 4
- Deaths: 2
- States: Minnesota, Ohio, Texas

npj | science of food

www.nature.com/npjscifood

REVIEW ARTICLE OPEN

Check for updates

An analysis of emerging food safety and fraud risks of novel insect proteins within complex supply chains

A. Traynor[1], D. Thorburn Burns[1], D. Wu[2], N. Karoonuthaisiri[1,3,4], A. Petchkongkaew[4,5] and C. T. Elliott[1,4,5]✉

Food consumption play a crucial role in human life, yet conventional food production and consumption patterns can be detrimental to the environment. Thus, research and development has been directed towards alternative proteins, with edible insects being promising sources. Edible insects have been recognised for their sustainable benefits providing protein, with less emission of greenhouse gas, land and water usage compared to sources, such as beef, chicken, and dairy products. Among the over 2000 known edible insect species, only four, namely yellow mealworm (*Tenebrio molitor*), migratory locust/grasshopper (*Locusta migratoria*), grain mould beetle, also known as lesser mealworm which is a larval form of *Alphitobius diaperinus* (from the family of Tenebrionidae of darkling beetles) and house cricket (*Acheta domesticus*), are currently authorised in specific products through specific producers in the EU. The expansion of such foods into Western diets face challenges such as consumer barriers, gaps in microbiological and chemical safety hazard data during production and processing, and the potential for fraudulent supply chain activity. The main aim of this study was to map the supply chain, through interviews with personnel along the supply chain, coupled with searches for relevant publications and governmental documents. Thus, the main potential points of food safety and fraud along the edible insect supply chain were identified. Feed substrate was identified as the main area of concern regarding microbiological and chemical food safety and novel processing techniques were forecast to be of most concern for future fraudulent activity. Despite the on-going authorisation of insect species in many countries there are substantial food safety and authenticity information gaps in this industry that need to be addressed before edible insects can be viewed as a safe and sustainable protein sources by Western consumers.

npj Science of Food (2024)8:7 ; https://doi.org/10.1038/s41538-023-00241-y

Diversified protein sourcing is on the 2024 agenda: What's the path to mainstream adoption?

By Natasha Spencer-Joilliffe
17-Jan-2024 Last updated on 17-Jan-2024 at 09:37 GMT

Manufacturers are turning their attention to finding new sources of protein, including diversified plant proteins, fungi, insects and more...GettyImages/Rimma_Bondarenko (Getty Images)

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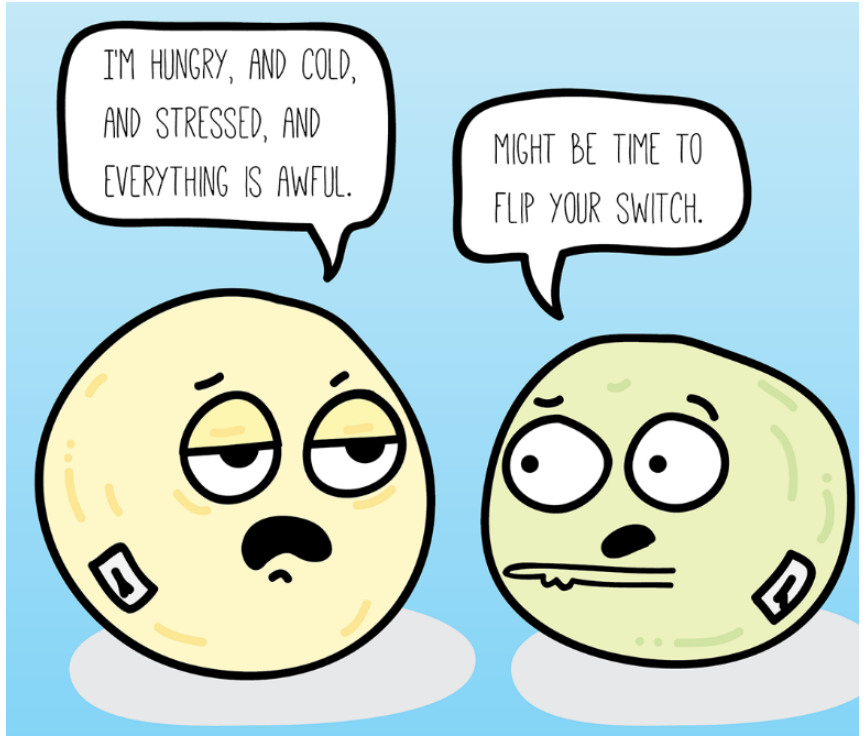
Microbial Goal?

Adapt & Survive OR Perish



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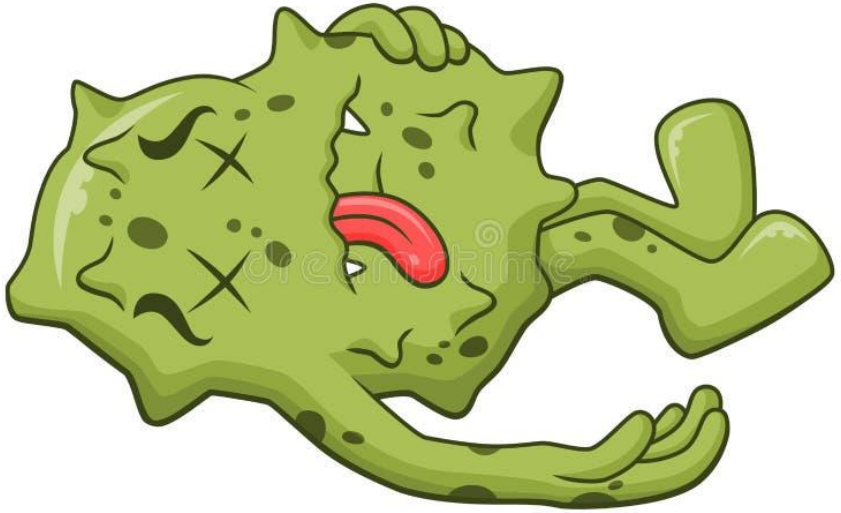

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Innovative Processing Technologies for Challenging Food Products

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Wednesday, May 14; 8:00am - 9:00am

Produced by FoodSafety magazine

Agenda

- Innovative Technologies: What, Why and How?
- Emerging, Re-emerging and Opportunistic Pathogens
- Challenges and opportunities
- Summary

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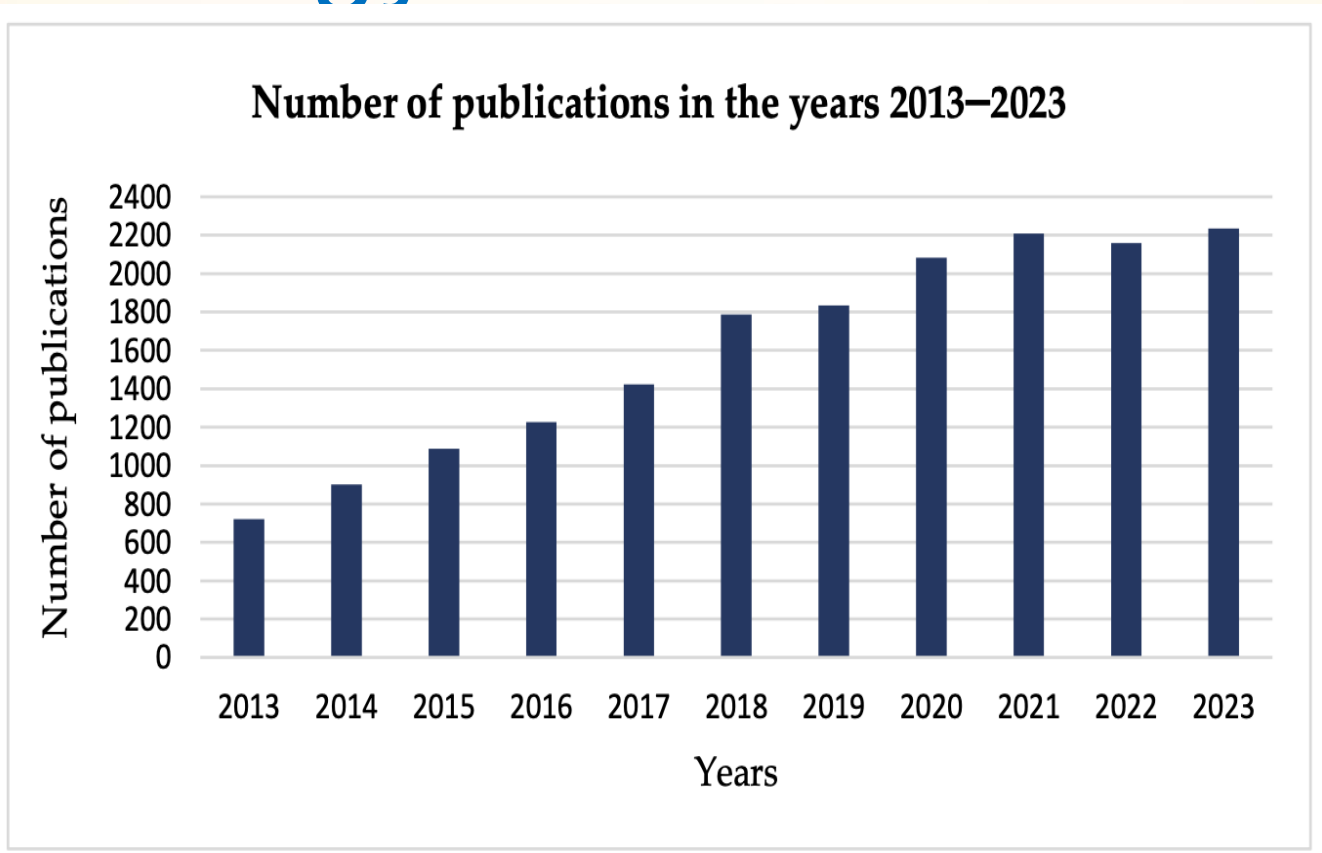
Dynamic Growth in Research Of Innovative Technology In Food Processing



Gazda, P.; Glibowski, P. 2024. Advanced Technologies in Food Processing—Development Perspective. Appl. Sci. 2024, 14, 3617.

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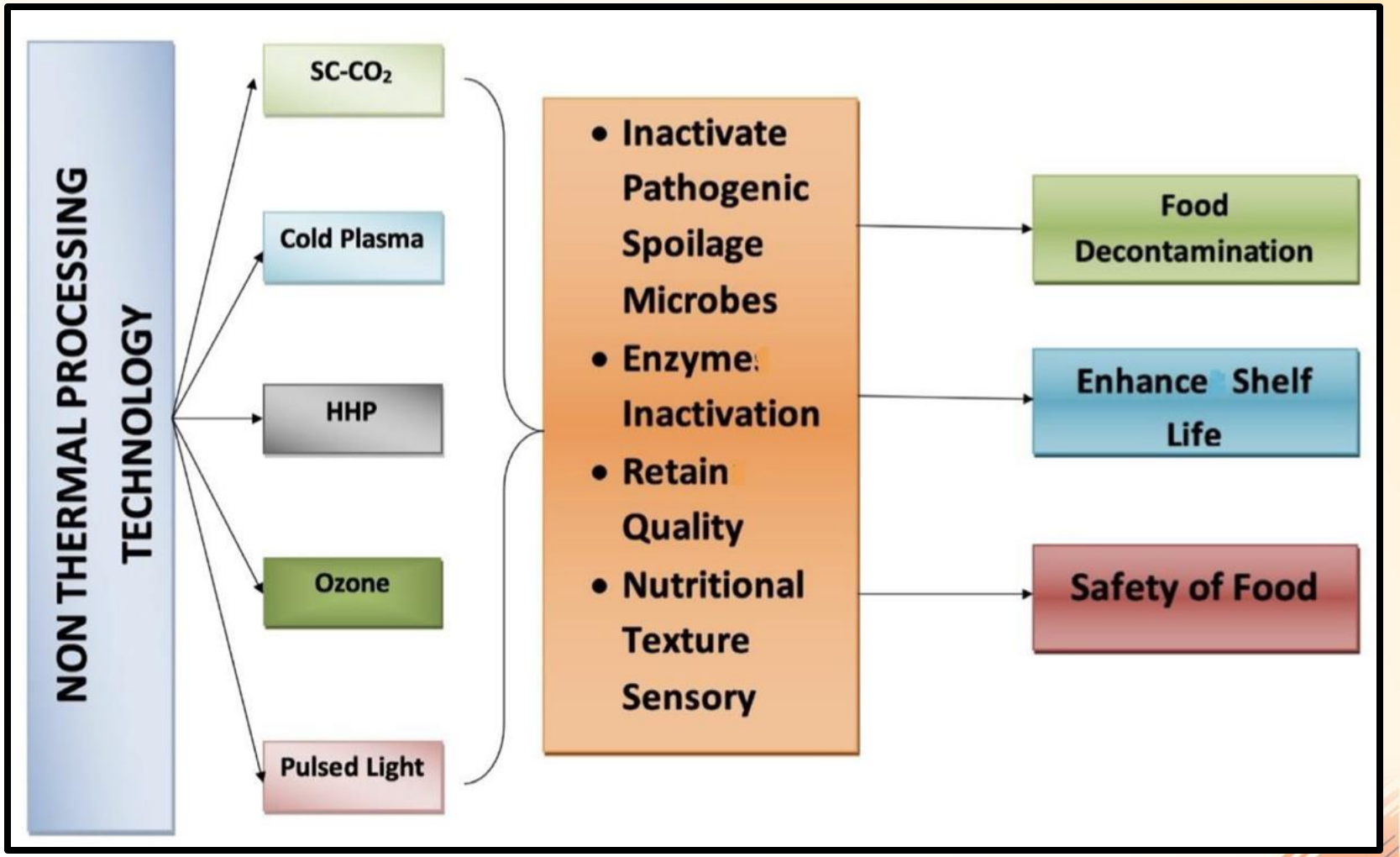
Innovative Technologies

- Microwave, Ohmic and Radio frequency heating
- PEF
- UV light
- Nanotechnology
- Biopreservation:
  - Starter and probiotic cultures
  - Bacteriophage and Endolysins



Allai, F. M., Z.R. A. A. Azad, N.A. Mir andK. Gul. 2023. Applied Food Research3. 100258

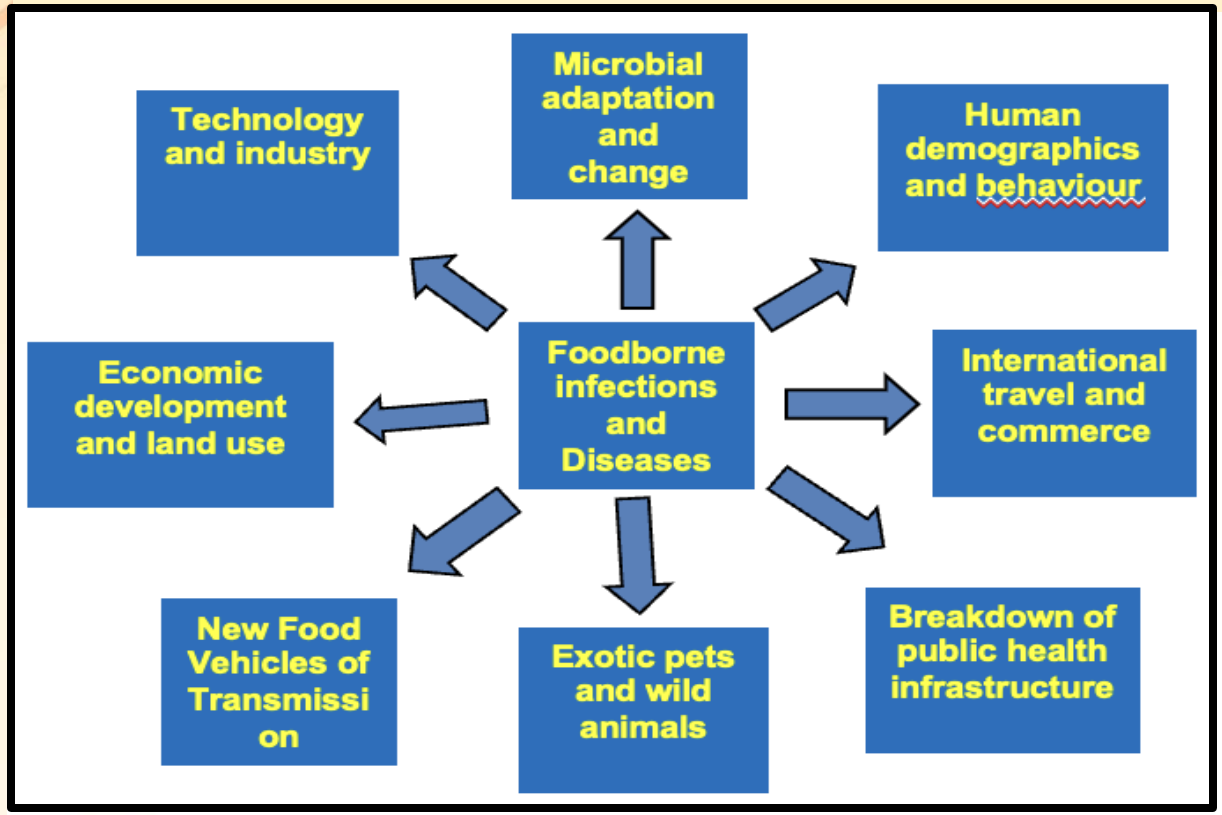
Emerging, Reemerging and Opportunistic Pathogens

- Emerging pathogens are New, reemerging, or drug-resistant infections whose incidence in humans have increased within the past two decades or threatened to increase in the near future

- Reemerging Pathogens- involved in the reappearance of a known disease following a decline in incidence including newly recognized pathogens, new diseases caused by known organisms, and the extension of the geographic or host range of a pathogen

- Opportunistic Pathogens- are microbes that usually do not cause disease in healthy people, but may become virulent with immunocompromised and unhealthy individuals

Factors Contributing to the Emergence of Foodborne Pathogens and Diseases



- Microbial adaptation and change
- Human susceptibility to infection
- Climate and weather
- Changing ecosystems
- Human demographics and behavior
- Economic development and land use
- International travel and commerce
- Technology and industry
- Breakdown of public health measures
- Other social, political and economic factors e.g. War and famine, Lack of political will, and Intent to harm

Emerging, Reemerging and Opportunistic Pathogens

Early 1900

- Typhoid fever
- Tuberculosis
- Septic sore throat
- Diphtheria
- Brucellosis

1940s-1960s

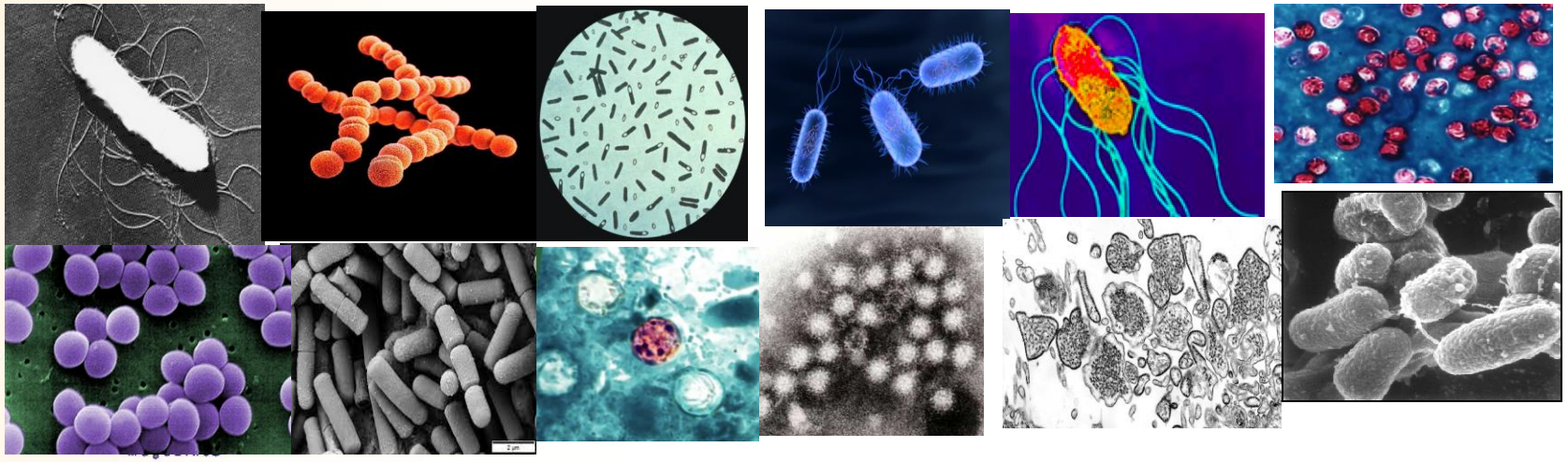
- Clostridium botulinum
- Salmonella Spp.
- Staphylococcus aureus
- Streptococci

1960s - 1990s

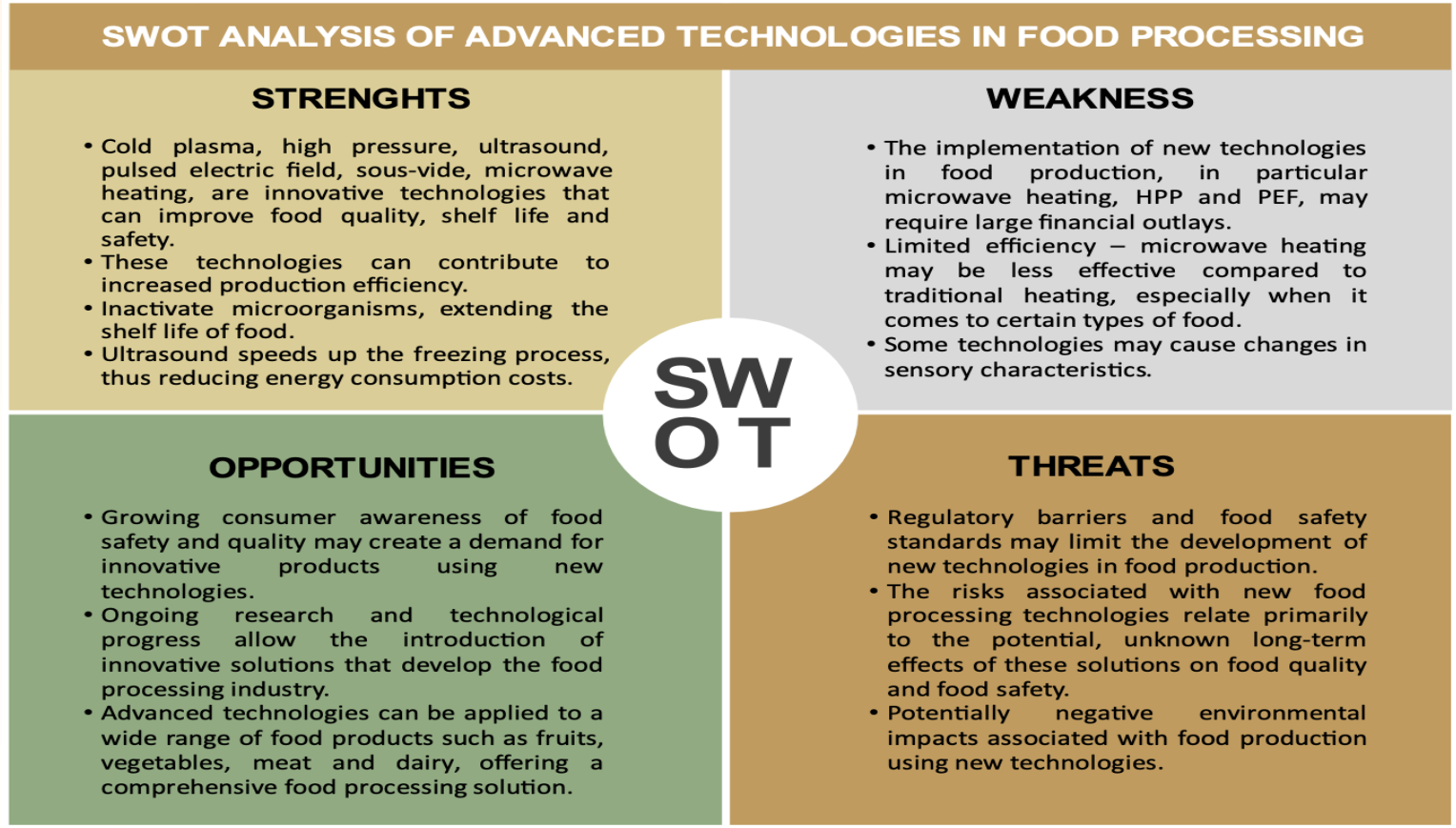
- Salmonella
- Clostridium perfringens
- Vibrio parahaemolyticus
- Bacillus cereus
- Pathogenic E. coli
- Campylobacter jejuni

2000 - s

- Salmonella Spp.
- E. coli 057:H7
- Non 0157 EHEC/STECs
- Listeria monocytogenes*
- Yersinia enterocolitica*
- Bacillus cereus*
- Staphylococcus aureus
- Cronobacter sakazakii
- Vibrio parahemolyticus
- V. vulnificus
- Cryptosporidium, Cyclospora, Toxoplasma gondii
- Norovirus, Hep A. Nipah Virus



SWOT Analysis



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Innovative Technologies : Advantages and Challenges

- Familiarity and perceived natural ness
- Higher functionality and nutritional value of products
- Broader applications
- Energy efficiency and environmental friendliness
- Regulatory recognition as safe and approval
- Industry and Consumer acceptance

Innovative Technologies : Advantages and Challenges

- Impact on nutritional value and sensory properties
- Higher investment cost and product price
- Association with radiation
- Consumer perception/concern about “ultra-processed”
- Concerns about changes in food composition
- Lack of information, limited understanding and consumer confusion

Summary

- Much progress made in innovative technologies for food processing
- Several thermal and non-thermal technologies are available as a stand alone or process augmentation step
- Energy efficiency, higher functionality and nutritional values
- Some technology may cause negative changes in nutritional and/or sensory characteristics
- Consumer perception and hesitancy
- Regulatory acceptance
- Industry acceptance and adoptation

Any Questions ???

Thank You !!

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