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Review Article

Sanitation: The Unsung Hero in Mitigating Foodborne Infections in Food Establishments

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Abstract

Foodborne infections, commonly known as food poisoning, represent a significant public health burden globally. They not only cause considerable morbidity and mortality but also impose substantial economic costs on individuals, healthcare systems, and the food industry. While various factors contribute to the occurrence of these infections, inadequate sanitation practices within food establishments stand out as a primary culprit. Food service establishments are any facility, where the food is prepared and served. Food safety in food service establishments/food areas is very crucial, Primarily, because most food borne illness outbreaks have involved food prepared away from home. There are some key aspects to control and prevent food borne illness like the personal hygiene practice, cleaning and disinfectants the overall surroundings in food service establishments, proper waste management, pest control, safe and adequate water supply, optimal temperature and comprehensive training and education. There are various preventive measures to control the rodents and pest infestations like keeping the premises clean, keeping the doors and 78 screened, keeping reusable boxes, crates etc., out of the kitchen, drains should be cleaned and in good condition, waste bin should be kept covered, periodic vermin elimination programme, the kitchen and the food preparation regions should be properly cleaned corner to corner and keeping it pest and rodent free.

Keywords: sanitation; establishments; handling

Introduction

Foodborne infections, commonly known as food poisoning, represent a significant public health burden globally. They not only cause considerable morbidity and mortality but also impose substantial economic costs on individuals, healthcare systems, and the food industry. Staphylococcus aureus, Salmonella, Shigella and Clostridium spp. Are important bacterial foodborne pathogens while HAV and Entamoeba spp. Are important foodborne viruses and parasites, respectively. While various factors contribute to the occurrence of these infections, inadequate sanitation practices within food establishments stand out as a primary culprit. From farm to fork, each stage of the food handling process presents opportunities for contamination, and robust sanitation protocols are the cornerstone of preventing these hazards from reaching consumers. This review article explores the critical role of sanitation in food establishments, discussing key aspects, challenges, and future directions in mitigating the risk of foodborne infections. The Burden of Foodborne Infections and the Role of Food Establishments are also discussed. Foodborne illnesses are caused by consuming food contaminated with pathogenic microorganisms (like bacteria, viruses, parasites), toxins produced by microorganisms, or chemical contaminants. The World Health Organization (WHO) estimates that globally, there occur about 600 million cases of foodborne illnesses annually, culminating in about 420,000 deaths. These infections can manifest with a wide range of symptoms, from mild gastrointestinal upset to severe and life-threatening conditions. Food service establishments are any facility, where the food is prepared and served. To elaborate further, it is actually a place where food is prepared and intended for individual portion service and includes the site at which the individual portions are provided, whether consumption occurs on or off the premises. The term, however, excludes food processing establishments, retail food stores, and private homes, where food is prepared or served for family consumption and food service operations. There a distinct group mutually provides, prepares, serves and

consumes the food limited to a congregation, club or organization. Food establishments, encompassing restaurants, cafes, catering services, food processing plants, and also retail food outlets, play a decisive and pivotal role in the food supply chain. They are responsible for preparing, processing, storing, and serving food to quite a large number of people. Consequently, lapses in sanitation within these establishments can exert widespread and devastating consequences, leading to outbreaks affecting numerous individuals at once. The complex nature of food handling in these settings, involving multiple steps, equipment, and personnel, creates ample opportunities for contamination if stringent sanitation measures are not implemented and consistently maintained. Food safety in food service establishments or food areas is very crucial. This is because most food borne illness outbreaks have occurred due to food prepared away from home. In a study conducted in the USA regarding the location of the outbreaks, it was found that majority of the outbreaks have been reported from the food service establishments, followed by outbreaks at home and food processing establishments. There are several reasons for the occurrence of food borne disease outbreaks. The most important of them are the factors which contribute to the contamination of foods by microorganisms or biological hazards, which when ingested, will lead to an outbreak.

These include:

i) factors which affect the growth of microorganisms
ii) factors which affect the survival of the pathogens, and
iii) factors which affect the contamination like food handlers and cross contamination.

Of all the factors which contributed to the outbreaks, the most important ones were:

i) preparation of foods too far in advance (lack of chilling after cooking)
ii) foods left at room temperature or foods cooked in large pots. Foods left open may be contaminated by Bacillus cereus.
iii) improper holding, like below 60°C
iv) improper cooling, e.g. leaving the cooked foods at room temperature or storing the foods in large containers in refrigerators
v) inadequate reheating. Sauteing the foods may lead to germination of spores of anaerobes and liberation of BoNT (Botulinum neurotoxin).
vi) handling of foods by colonized or infected persons. Hence social hand washing is a must.
vii) inadequate cleaning of equipment and utensils may transmit pathogens to food. Hence brisk washing of vegetables in running water is recommended.
viii) cross contamination from raw to cooked foods can occur. Hence keeping in separate containers is needed.
ix) toxic containers, and
x) contaminated raw ingredients.
xi) During cooking chicken pieces the temperature should reach 72 degree C in periosteum of bone, to destroy bird flu virus (H5N1).

Food stands, fixed establishments and other food sales shops provide good opportunities for the organizations to raise money, but the food they prepare and offer for sale must also be safe for the consumer. When we, the customers buy food, we also have the right to expect that it will be safe and wholesome. A three-word definition of food sanitation is protection from contamination. Primarily, the term ‘sanitation’ is derived from the Latin word Sanitas, which means health. Sanitation implies creating and maintaining hygienic and healthful conditions. Food sanitation means creating and maintaining hygienic and healthy conditions in food preparation, storing and serving areas. Sanitation is a dynamic and ongoing process and cannot be sporadic or something that can be turned on once a day, once a week, etc. Therefore, another definition could be that sanitation is a way of life. There should be no two views about the fact that all food products must be protected from contamination from receiving through distribution, or ‘from farm to fork’. Contamination from microorganisms which can cause food spoilage and food borne diseases. Sanitary practices and hygienic conditions are very important because food is being processed, prepared and sold in larger volumes than before. Sanitation can cut down contamination of food by microorganisms which are a major cause of food borne illnesses. Furthermore, sanitary principles also apply to waste disposal and can help mitigate pollution and improve ecological balance in and around the food service unit. All plants and animals have a natural microflora associated with it. These microflora are one of the sources of microorganisms associated with spoilage. Equipment, employees, air and water, insects, rodents and sewage are potential sources of contamination. Therefore, healthy sanitary practices, appropriate cleaning programmes and pest management systems must be developed and also implemented within the food service establishments to prevent microbial contamination and ensure safe food. Cleaning and sanitization should hence be accorded utmost priority. By cleaning it means, free from dirt, stain, or impurities, unsoiled. The cleaning process, therefore, primarily removes the soil deposits. Sanitizing, on the other hand, destroys microbes which are left on cleaned surfaces. Various cleaning agents, sanitizers, disinfectants are available and approved for use in food service units.

Key Aspects of Sanitation in Food Establishments

Effective sanitation in food establishments is a multifaceted endeavor encompassing several crucial elements:

1. Personal Hygiene Practices:

The hygiene of food handlers is paramount in preventing the introduction and spread of pathogens. This includes:

* Handwashing: Frequent and thorough 6-step social handwashing with soap and water for at least 20 seconds is the single most effective measure to remove transient microorganisms. This should be performed before starting work, before eating, after defecation, after using the restroom, after handling raw foods, after touching contaminated surfaces, and after coughing or sneezing.
* Protective Clothing: Wearing clean and appropriate protective clothing, such as aprons, gloves, and hairnets or caps, minimizes the risk of transferring contaminants from body to food. Gloves should be changed frequently, especially between handling raw and ready-to-eat foods.
* Health Status: Food handlers suffering from infectious diseases, particularly those involving gastrointestinal symptoms or skin lesions, should be excluded from food handling duties to prevent transmission. Regular health check-ups and training on recognizing symptoms of foodborne illnesses are also essential.
* Personal Habits: Practices like eating, drinking, and smoking should be restricted to designated areas away from the food preparation and storage zones. Covering coughs and sneezes and proper disposal of used tissue papers are also crucial.

2. Cleaning and Disinfection:

Maintaining a clean and disinfected environment is fundamental to eliminating microorganisms and preventing cross-contamination. This involves:

- **Cleaning:** The physical removal of visible dirt, food debris, grease, and other organic matter from surfaces and equipment using detergents and scrubbing. Effective cleaning is a prerequisite for effective disinfection.
- **Disinfection:** The use of chemical or physical agents to reduce the number of viable microorganisms to a safe level. Common disinfectants include chlorine-based solutions, quaternary ammonium compounds, and hydrogen peroxide. The choice of disinfectant and its concentration and contact time are critical for efficacy.
- **Cleaning Schedules:** Implementing and adhering to regular cleaning schedules for all areas, including food preparation surfaces, equipment, floors, walls, ceilings, and restrooms, is essential. The frequency of cleaning should be based on the level of use and potential for contamination.
- Cooked food should be kept covered.
- **Equipment Cleaning:** Thorough cleaning and disinfection of all food contact surfaces and equipment, such as cutting boards, utensils, blenders, and slicers, after each use is crucial to prevent the transfer of pathogens between different foods.

3. Waste Management:

Proper management of waste is vital to prevent the attraction of pests and mechanical vectors like flues and cockroaches and the spread of pathogens. This includes:

- **Waste Collection and Storage:** Providing sufficient and appropriate containers for waste, ensuring they are emptied regularly and cleaned and disinfected. Waste storage areas should be located away from food handling areas and should be pest-proof.
- **Waste Disposal:** Implementing safe and hygienic waste disposal methods in accordance with local regulations is a must.

4. Pest Control:

Pests such as rodents, insects, and birds can carry and transmit pathogens, contaminating food and food contact surfaces. Effective pest control measures include:

- **Preventative Measures:** Designing and maintaining facilities to prevent pest entry, such as sealing cracks and openings, fitting screens on windows, and practicing good housekeeping. Cobwebs should be cleaned since it attracts dirt.
- **Detection and Elimination:** Implementing monitoring systems to detect pest infestations early and employing appropriate control measures, such as traps and baits, when necessary, should be there. Pest control should be carried out by trained personnel to avoid chemical contamination of food. Food also should be kept covered till they cool down. Figure 1 below shows covered food.

Figure: 1. Food covered after cooking.

5. Facility Design and Maintenance:

The design and maintenance of food establishment facilities play a crucial role in facilitating effective sanitation:

- **Layout and Workflow:** Designing the layout to ensure a smooth flow of food preparation, minimizing the risk of cross-contamination between raw and ready-to-eat foods. Adequate space for cleaning and maintenance should be provided.
- **Materials and Construction:** Using materials that are durable, easily cleanable, and non-toxic for surfaces that come into contact with food. Proper drainage and ventilation are also essential.
- **Equipment Design:** Selecting equipment that is easy to clean and maintain, with smooth surfaces and minimal crevices where food debris and microorganisms can accumulate.
- **Maintenance:** Implementing a regular maintenance program for all equipment and facilities to ensure they are in good working order and do not pose a contamination risk.

6. Water Quality and Supply:

A safe and adequate supply of potable water is essential for cleaning, sanitation, and also food preparation. Regular monitoring of water quality (bacteriological and chemical) is necessary to ensure it meets safety standards.

7. Temperature Control:

Maintaining appropriate temperatures for food storage, preparation, and holding is critical for inhibiting the growth of pathogenic microorganisms. This includes:

- Cold Storage: Storing perishable foods at temperatures below 5°C (41°F) to slow down bacterial growth.
- Hot Holding: Holding cooked foods at temperatures above 60°C (140°F) to prevent bacterial multiplication.
- Cooking Temperatures: Cooking foods to the recommended internal temperatures to kill harmful microorganisms.
- Temperature Monitoring: Regularly monitoring and recording food temperatures using calibrated thermometers.

8. Training and Education:

Providing comprehensive and ongoing training to all food handlers on proper sanitation and hygiene practices is crucial for ensuring consistent adherence to protocols. Training should cover topics such as handwashing techniques, cleaning and disinfection procedures, personal hygiene standards, temperature control, and the identification of potential food safety hazards.

Challenges to Effective Sanitation in Food Establishments

Despite the well-established importance of sanitation, food establishments face several challenges in implementing and maintaining effective protocols:

- Resource Constraints: Small and medium-sized enterprises (SMEs) may face financial and staffing limitations that hinder their ability to invest in adequate sanitation infrastructure, equipment, and training.
- High Staff Turnover: Frequent changes in personnel can make it challenging to ensure that all food handlers are adequately trained and consistently follow sanitation procedures.
- Language and Cultural Barriers: In diverse workforces, communication and understanding of sanitation protocols can be hindered by language and cultural differences.
- Time Pressures: During peak service hours, staff may be tempted to cut corners on sanitation procedures to save time.
- Complacency and Lack of Awareness: A lack of understanding of the potential consequences of poor sanitation can lead to complacency and inconsistent adherence to protocols.
- Complexity of Regulations: Navigating and complying with varying food safety regulations at local, national, and international levels can be challenging for food businesses.
- Emerging Pathogens and Changing Food Trends: The emergence of new foodborne pathogens and evolving food preparation and consumption trends necessitate continuous adaptation of sanitation strategies.
- Strategies for Enhancing Sanitation and Mitigating Foodborne Infections

To overcome these challenges and strengthen sanitation practices in food establishments, several strategies can be implemented:

- Strengthening Regulatory Frameworks: Governments and regulatory bodies should establish clear, comprehensive, and enforceable food safety regulations, including specific requirements for sanitation.
- Promoting Food Safety Culture: Fostering a strong food safety culture within food establishments, where all employees understand the importance of sanitation and are committed to following best practices. This requires strong leadership, open communication, and employee empowerment.
- Implementing Hazard Analysis and Critical Control Points (HACCP): Adopting a HACCP system, a systematic approach to identifying, evaluating, and controlling food safety hazards, can significantly enhance sanitation and prevent foodborne illnesses.
- Utilizing Technology: Implementing technological solutions such as automated cleaning systems, temperature monitoring devices, and digital record-keeping can improve efficiency and accuracy in sanitation practices.
- Enhancing Training and Education: Developing engaging and accessible training programs that address the specific needs of different food handlers, utilizing diverse training methods, and ensuring regular refresher courses.
- Improving Surveillance and Outbreak Investigations: Strengthening surveillance systems to detect foodborne illness outbreaks promptly and conducting thorough investigations to identify the source of contamination and implement corrective actions.
- Public Awareness Campaigns: Educating consumers about safe food handling practices at home can complement efforts in food establishments and reduce the overall burden of foodborne illnesses.
- Collaboration and Information Sharing: Fostering collaboration between food businesses, regulatory agencies, research institutions, and public health organizations to share best practices, research findings, and lessons learned from outbreaks.
- Future Directions in Sanitation for Food Safety

The field of food safety is constantly evolving, and future directions in sanitation will likely focus on:

- Advanced Cleaning and Disinfection Technologies: Exploring and implementing innovative cleaning and disinfection technologies, such as UV-C light disinfection, ozone treatment, and antimicrobial coatings, to enhance effectiveness and efficiency.
- Real-time Monitoring and Data Analytics: Utilizing sensors and data analytics to continuously monitor sanitation parameters, such as temperature, humidity, and cleaning effectiveness, allowing for proactive intervention and identification of potential risks.
- Personalized Hygiene Interventions: Developing tailored hygiene interventions based on individual risk factors and behaviors to improve compliance among food handlers.
- Integration of Sustainability Principles: Adopting sanitation practices that are environmentally sustainable, such as reducing water and energy consumption and using eco-friendly cleaning products.

* Predictive Modeling and Risk Assessment: Utilizing predictive modeling to identify high-risk areas and processes within food establishments and implement targeted sanitation measures.

Cleaning agents used as sanitizing compounds.

a) Cleaning substances of natural origin Bengal gram powder or besan is a natural cleaning powder that has been used in India, since times immemorial. It has been traditionally used to remove oily adherences of cooking utensils.

b) Alkaline cleaning compounds Carbonates, bicarbonates, hydroxides of various metals are called alkaline compounds. Alkaline cleaning compounds have a pH between 7 and 14. Cleaning compounds which have a pH near 14 are called strong alkaline cleaners, e.g. sodium hydroxide, which destroys microbes, dissolves protein and effectively disperses and emulsifies the soil. Use of silicates with sodium hydroxide makes it less corrosive but improves its penetrating and soil removing property. These are used specially in commercial ovens and smokehouses. These cleaners have strong dissolving powers and are very corrosive. If these come in contact with skin, they can lead to burns, ulcers and sc~trring. In fact, prolonged contact may cause permanent damage. Inhaling its mist can cause lung damage. Another type of alkaline cleaner is heavy-duty alkaline cleaners. These have moderate dissolving powers and are either slightly corrosive or not corrosive at all. These are often used for cleaning in-place or high pressure or other mechanized systems. They are very good at removing fats but do not remove mineral deposits. One of the widely used and cheap heavy-duty cleaners is sodium carbonate. Now, we come on to the third category i.e. mild alkaline cleaners. These are used to clean lightly soiled areas by hand. These compounds are good at softening water but do not remove mineral deposits. Sodium bicarbonate is an example of a mild alkaline cleaner.

c) Acid cleaning: Acid-based cleaners like phosphoric acid and hydrofluoric acid are commonly used. They are very useful in removing minimal scales that are dried on or encrusted on equipment or utensils surfaces. They are especially good at removing mineral deposits on metal surfaces. The acid cleaners dissolve the minerals in the deposits so that they can be easily removed. Organic acids, such as citric acid, tartaric acid are also used as cleaning compounds and are excellent water softeners, rinse off easily and do not corrode surfaces or irritate the skin. Inorganic acids, though excellent at removing and controlling mineral deposits, can be very corrosive to surfaces and irritating to the skin. These are used for special cleaning purposes, and are comparatively less effective against the soil caused by fats, oils and proteins. Like the alkaline cleaning compounds, acid cleaning compounds can also be classified into strongly acid cleaners and mildly acid cleaners. The strongly acid cleaners corrode concrete, most metals and fabrics. Further, if heated, it produces corrosive and toxic gases, which can damage the lungs. However, they are very effective cleaning agents. They remove encrusted surface matter and mineral scale from stem equipment, boilers and some food-processing equipment. The most commonly used strong acid cleaner is phosphoric acid, as it works well with many surfactants and are not very corrosive. Hydrofluoric acid is another acid cleaner, however, it is corrosive to stainless steel and dangerous to handle because it tends to release hydrogen gas. Mildly acid cleaners are slightly corrosive and may cause sensitive reactions. A few examples are hydroxyacetic, acetic and gluconic acid. Cleaners like acetic acid and gluconic acid are good manual cleaners.

d) soaps and detergent: soaps and detergents emulsify fats, oils and grease so that they are easily washed away. They usually contain chemical builders to enhance their cleaning efficiency. Soap is an oldest and best cleaning compound used but it forms an insoluble curd with hard water, hence not preferred. Instead, detergents are used. A detergent is a substance which assists in cleaning when added to water. These are normally sodium salts of fatty acids. To be effective, a detergent must have a good wetting capacity and the ability to remove soil from surfaces and carry away residues. Soaps and detergents for household cleaning have a pH of 8.0 to 9.5.

e) Solvent cleaners: Solvent cleaners are based on ether or alcohol and work well on soils caused by petroleum products, such as lubricating oils and greases. These are used to remove large amounts of petroleum deposits in areas free of protein-based and greasy soils. They may be mixed with wetting agents, water softeners and other additives. In addition to these cleaning compounds discussed above, depending upon the type of food debris, certain additives are also used as cleaning agents for better performance. They may be: sequestrants, which chelate metals like magnesium and calcium and prevent their interaction with food components or utensils. It actually is a chemical added to cleaning compounds to prevent the salts of calcium and magnesium in hard water from forming deposits on equipment surfaces.

f) Surfactants- In the food industry, surfactants like anionic and non-ionic types are used as cleaning agents to remove dirt, grease, and food residues from surfaces, and also as emulsifiers and wetting agents in food products.

Types of surfactants used in food industry:

Anionic Surfactants:

These are negatively charged and are effective at removing positively charged dirt and grease.

- Examples: Sodium Lauryl Sulfate (SLS), Sodium Laureth Sulfate (SLES), Alkylbenzene sulfonates.

Non-ionic Surfactants:

These are neutral and good at emulsifying oils and removing organic soils.

- Examples: Polysorbates, ethoxylates.

Amphoteric Surfactants:

These have both positive and negative charges and are versatile cleaning agents.

- Examples: alkyl amido propyl amine N-oxide (APAO), alkyldimethylamine N-oxide (AO), alkyl betaine (Bt) and alkyl amidopropyl betaine (APB).

Biosurfactants:

These are derived from microbial sources and are biodegradable and biocompatible.

- Examples: Lipids, carbohydrates, or proteins from microorganisms.

g) Sanitizing Chemicals: The food industry most often uses sanitizing procedures, so the information presented herein will focus on the more common products utilized. Regardless of the product, the sanitizing solution must be tested to verify that the desired concentration is consistently present. Too little sanitizer, of course, can result in unacceptable efficacy, while too much sanitizer can yield residues that do not meet standards.

Hypochlorites

Effectiveness, low cost and ease of manufacturing make hypochlorites the most widely used sanitizers. Sodium hypochlorite is the most common compound and is an ideal sanitizer, as it is a strong oxidizer.

Hypochlorites cause broad microbial mortality by damaging the outer membrane, likely producing a loss of permeability control and eventual lysis of the cell.In addition, these compounds inhibit cellular enzymes and destroy DNA. Spores, however, are resistant to hypochlorites, as the spore coat is not susceptible to oxidation except at high concentrations coupled with long contact times at elevated temperatures. While hypochlorites are very reactive, their useful properties are negatively impacted by factors such as suspended solids, high temperatures, light, water impurities and improper pH levels. In routine use, surfaces must be as free as possible of organic materials, and the pH must be maintained between 5 to 7 to ensure that the greatest amount of hypochlorous acid is available. As with any sanitizer, measurements must be taken periodically to make certain that the freely available chlorine is at the desired level. For no-rinse applications, the maximum allowable concentration of available chlorine is 200 ppm.

Other disadvantages of hypochlorites are corrosiveness to metals, health concerns related to skin irritation and mucous membrane damage and environmental contamination. The latter is of concern as chlorine can combine with organic substances to form toxic chlorinated compounds, such as trihalomethanes and dioxins. Hypochlorite use may be further restricted in the future. Care must be taken when cleaning hypochlorite spills as organic materials such as cloth, sawdust and paper may spontaneously combust upon drying.

Chlorine Dioxide

This inorganic compound is a broad sanitizer effective against bacteria, fungi and viruses. Chlorine dioxide is an oxidizer that reacts with the proteins and fatty acids within the cell membrane, resulting in loss of permeability control and disruption of protein synthesis. While chlorine dioxide is an explosive gas, it is relatively safe in solution. It is produced on-site as it can't be compressed or stored commercially in gaseous form. Most chlorine dioxide generation is accomplished with complex systems. However, recent advances in formulation procedures allow the production of solutions of chlorine dioxide on-site without the use of expensive equipment. Compared with hypochlorites, chlorine dioxide requires much lower concentrations to achieve microbial mortality. For example, a 5-ppm solution is effective as a sanitizer on food contact surfaces with a contact time of at least 1 minute. Further, disinfection can be achieved with 100 ppm using a contact time of 10 minutes. Chlorine dioxide reacts more selectively with compounds present in microbial cells as opposed to reacting with organic compounds in general. This ability allows chlorine dioxide to function in more organically loaded solutions, though as organic load increases, efficacy does decrease. Chlorine dioxide functions well over a pH range of about 6 to 10, thus allowing increased mortality of some microbes at higher values. Another advantage is that chlorine dioxide does not form chlorinated organic compounds, making it more environmentally friendly.

Iodophores:

These compounds are less active than hypochlorites but are effective sanitizers and disinfectants. Iodophors attach to the sulfurs of proteins such as cysteine, causing inactivation and cell wall damage. Carriers with iodophor solutions allow a sustained-release effect, resulting in continuous microbial mortality.

Iodophors fare better in situations in which the pH is slightly acidic, as less active forms exist above neutral pH. The common concentration for sanitization is 25 ppm for 1 minute. Unfortunately, iodine compounds easily stain many surfaces, particularly plastics. On the plus side, they are common sanitizers used on glass surfaces, such as in the beer and wine bottling industries. The EPA has assessed iodophors as having no significant effect on the environment.

Peroxyacetic Acid (PAA)

PAA is an effective sanitizer that is active against many microorganisms and their spores. Mortality is produced by the disruption of chemical bonds within the cell membrane. PAA-based sanitizers are frequently paired with stabilized hydrogen peroxide. These sanitizers function well under cold conditions (~ 4 °C), thus producing acceptable microbial mortality on equipment normally held below ambient temperature. PAA is also effective in removing biofilms and is more active than hypochlorites. PAA solutions can be attenuated by the organic load and will begin to lose activity as the pH approaches neutral. These solutions are applied at concentrations ranging from about 100 ppm to 200 ppm for peroxyacetic acid and 80 ppm to 600 ppm for hydrogen peroxide. PAA-based sanitizers are environmentally friendly as the compounds therein break down into acetic acid, oxygen and water. These sanitizers are also less corrosive to equipment than hypochlorites. As with any highly active oxidizer, concentrated PAA can present a safety hazard.

Quaternary Ammonium Compounds (QACs or Quats)

Quaternary ammonium compounds are fairly complex chemicals in which nitrogen is bound to four organic groups. The positively charged cations in the compounds bind with the acidic phospholipids in the microbial cell wall. This action blocks the uptake of nutrients into the microbial cell and prevents the discharge of waste. In general, QACs are effective against a wide range of microbes, although the spore phase is unaffected. At lower concentrations, Gram-positive bacteria are more sensitive to QACs than Gram-negative bacteria.10 QACs are formulated in many different variations for specific situations. QACs may be applied at concentrations varying from about 100 ppm to 400 ppm. As sanitizers, QACs are commonly applied at 200 ppm to food contact surfaces, and the solution is allowed to dry. Once dry, a residue of the QAC compounds remains and provides germicidal activity until degradation occurs. QACs also can function as detergents when present in high concentration because the compounds possess both hydrophilic and lipophilic chemical groups. QACs are usually odorless, non staining, non corrosive and relatively nontoxic to users. They function well over a broad temperature range and a wide pH range, although activity is greater at warmer temperatures and in alkaline situations. While QACs tolerate light organic loads, heavy soil will decrease QAC activity significantly. Some QACs may not function adequately in hard water, but others are formulated with added chelating agents that allow such use.[11]

While QACs do combine with organic compounds and are discharged into the environment, the concentrations are low and heterotrophic bacteria are not negatively impacted. Soil-inhabiting bacteria such as Pseudomonas spp. and Xanthomonas spp. can degrade QACs. In addition, the low amounts of QACs flowing into commercial sewage treatment facilities appear to combine with the anionic surfactants present to form complexes that reduce or eliminate toxicity.

Heat

Heat is an inefficient sanitizer because it takes so much energy. The efficiency of heat depends on the humidity, the temperature required, and the length of time it takes to destroy microbes at that temperature. Heat destroys microorganisms if the temperature is high enough for long enough and if the design of the equipment or plant allows the heat to reach every area. Cleaning staff should use accurate thermometers to measure temperatures during cleaning to make sure that equipment and surfaces are properly sanitized. Steam and hot water are the most common types of heat used for sterilization.

Steam

Sanitizing with steam is expensive because of high energy costs, and it is usually ineffective. Workers often mistake water vapor for steam, so the temperature usually is not high enough to sterilize the equipment or surface. Steam can make bacteria and soil cake onto the surface so that the heat does not reach the microbes; then they stay alive.

Radiation

Radiation in the form of ultraviolet light or high-energy cathode or gamma rays destroys microorganisms. For example, hospitals and homes may use ultraviolet light from low-pressure mercury vapor lamps to destroy microorganisms. Ultraviolet units are already used in Europe and are starting to be used in the United States to disinfect water for drinking and food processing. Generally, the food industry uses radiation to destroy microorganisms in and on fruits, vegetables, and spices; trichinella in pork; and Salmonella in poultry. It does not work very well in food plants and foodservice facilities because the light rays must actually hit the microorganisms and only kill microbes that are very close by. Some bacteria are more resistant to radiation and need a longer exposure for the radiation to destroy them. Dust, grease, and opaque or cloudy solutions absorb radiation and prevent it from killing microbes.

Hot Water

- Immersing small components (such as knives, small parts, eating utensils, and small containers) into water heated to 82°C (l80°F) or higher is another way to sterilize using heat. Pouring hot water into containers is not a reliable way to sterilize, because it is difficult to keep the water hot enough for long enough. Hot water can sanitize food-contact surfaces, plates, and utensils, although spores may survive more than an hour of boiling temperatures. The time needed to sterilize an item depends on the temperature of the water. If equipment or surfaces are sterilized at a lower temperature, they must be kept at that temperature for longer. If they will be sterilized for a shorter amount of time, the temperature must be higher. This is known as a "time-temperature relationship." Examples of times and temperatures used for sterilization are 15 minutes of heat at 85°C (l85°F), or 20 minutes at 82°C (l80°F). The volume of water and how fast it is flowing can determine how long it takes for the item being sterilized to reach the right temperature. Hot water is readily available and is not toxic. To sanitize equipment, water can be pumped through it while it is still assembled, or it can be immersed in water

Prevention

Best preventive measure is to correct all dripping taps, repair defective gutters and also make the food unavailable by proper storage of foods in metal containers. The empty cartons, boxes should be stacked on a pallet and away from walls, as rats prefer to move nearer to the walls. Here, it can be summarized that pest control is essential in any food service establishment because of: preventing the spread of disease preventing the wastage of food preventing damage generally caused by gnawing of electric cables or pipes, and preventing loss of customers who are well-aware and educated about hazards of eating in infest premises.

Food refuse containers should be cleaned after discarding. Care has to be taken to remove food scraps, crumbs, vegetable peelings etc. They should not be left on the floor and ensure that premises are as clean and neat as possible. The rodents can be refused entry into the building by rodent proofing the building by changing the defective doors, windows, cupboards and covering up of small openings especially the corners of doors and windows, pipes, floor drains, exhaust fan openings. To control. the rodents, either traps or poisoning is employed. Care has to be taken while rodenticides are employed as their poisons are harmful to human beings. The rodent eradication programme has to be undertaken by an experienced and trained person. A properly planned and maintained premises and periodic checks of food storage area and waste management helps in preventing the pests' entry into the food service establishment. To protect the premises from insects, rodents and pests and reduce the risk of infestation, the following points have to be kept in mind: Keep the premises clean Clean all spillages promptly Check all incoming goods and boxes Keep doors and windows screened Keep reusable boxes, crates etc. out of the kitchen Keep drains clean and in good condition Cover the waste bin. Empty accumulated wastes promptly and wash it regularly along with the surrounding area Keep the shelves, cupboards and drawers in good repair Use of proper "dunnage" racks below stored products, so that the areas can be cleaned without difficulty and moisture does not migrate Sightings of pests or pest damage are reported to management Periodically undertake vermin elimination programme with the help of a trained person.

Home Health Emergencies WHO "Golden Rules" for Safe Food Preparation

WHO "Golden Rules" for Safe Food Preparation

WHO data indicate that only a small number of factors related to food handling are responsible for a large proportion of foodborne disease episodes everywhere. Common errors include:

preparation of food several hours prior to consumption, combined with its storage at temperatures which favour growth of pathogenic bacteria and/or formation of toxins;

insufficient cooking or reheating of food to reduce or eliminate pathogens;

cross contamination; and people with poor personal hygiene handling the food. The Ten Golden Rules respond to these errors, offering advice that can reduce the risk that foodborne pathogens will be able to contaminate, to survive or to multiply. Despite the universality of these causes, the plurality of cultural settings means that the rules should be seen as a model for the development of culture-specific educational remedies. Users are therefore encouraged to adapt these rules to bring home messages that are specific to

food preparation habits in a given cultural setting. Their power to change habitual practices will be all the greater. If you have any comments, please send them to FOS by clicking here: foodsafety@who.int. The World Health Organization regards illness due to contaminated food as one of the most widespread health problems in the contemporary world. For infants, immunocompromised people, pregnant women and the elderly, the consequences can be fatal. Protect your family by following these basic rules. They will reduce the risk of foodborne disease significantly. WHO "Golden Rules" for Safe Food Preparation. WHO data indicate that only a small number of factors related to food handling are responsible for a large proportion of foodborne disease episodes everywhere. Common errors include: preparation of food several hours prior to consumption, combined with its storage at temperatures which favour growth of pathogenic bacteria and/or formation of toxins; insufficient cooking or reheating of food to reduce or eliminate pathogens; cross contamination; and people with poor personal hygiene handling the food. The Ten Golden Rules respond to these errors, offering advice that can reduce the risk that foodborne pathogens will be able to contaminate, to survive or to multiply. HACCP stands for Hazard analysis and critical control points. Here risk means anything that makes food vulnerable to contamination by microbes. Hazard means the microbe that enters the food supply due to this risk. Critical control points mean factors like temperature, cooking time and relative humidity which are key to mitigating hazards entering food supply. HACCP entails 7 steps like assessing risk, assessing hazard, making team, documentation, correcting the shortcomings and feedback.

These are the WHO "Golden Rules" to ensure food safety in food establishments:

1. Choose foods processed for safety
2. Cook food thoroughly
3. Eat cooked foods immediately
4. Store cooked foods carefully
5. Reheat cooked foods thoroughly
6. Avoid contact between raw foods and cooked foods
7. Wash hands repeatedly
8. Keep all kitchen surfaces meticulously clean
9. Protect foods from insects, rodents, and other animal
10. Use safe water.

Figure 2 below highlights steps of hand washing with respect to food safety.

Figure 2: steps of hand washing.

Discussion:

Food establishments and holdings have led to foodborne illnesses and foods responsible are samosa, jhalmuri and other foods. Food safety is deemed to be very important now, especially in food establishments. These are needed to avert incidents like food poisoning and other foodborne illnesses. Simple principles of cleaning, separation, cooking and chilling hold good in preventing foodborne illnesses. Hand hygiene is very important too, in form of social hand washing. Food establishments should be clean, and bereft of cockroaches and flies, which may act as mechanical vectors. HACCP principles are also very important and should be applied wherever possible in the food establishments. Head should be covered with cap while cooking. Water used for cooking should be potable and safe from microbiological and chemical viewpoint. These things should be stressed upon in all food establishments in order to keep at bay various microbial hazards.

Conclusion:

Sanitation is an indispensable pillar of food safety in food establishments. Implementing and consistently maintaining robust sanitation practices is crucial for preventing foodborne infections and protecting public health. While challenges continue to exist, a multi-faceted approach involving strong regulatory frameworks, a positive food safety culture, effective training, the strict adoption of HACCP principles, and the utilization of technology can significantly enhance sanitation standards. Continuous innovation and a commitment to ongoing improvement are essential to ensure that food establishments create safe and wholesome food for consumers, thereby reducing the significant burden of foodborne illnesses. Recognizing sanitation as the unsung hero in food safety is paramount for creating a healthier and safer food supply for all.

References:

1) https://microbenotes.com/physical-methods-of-sterilization/
2) https://www.mdpi.com/2076-0817/11/1/83
3) https://www.cdc.gov/infection-control/hcp/disinfection-sterilization/other-sterilization-methods.html
4) https://www.paho.org/en/health-emergencies/who-golden-rules-safe-food-preparation
5) https://www.who.int/news-room/fact-sheets/detail/food-safety
6) https://www.qualityassurancemag.com/article/the-importance-of-food-safety-sanitation

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