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Food Safety Programs that should be Implemented in Slaughterhouses: Review

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ABSTRACT

Fresh meat and poultry meat are easily contaminated with various contaminants especially if it is not properly handled and preserved, leading to loss of quality and potential public health problems. Food safety addresses the accidental contamination of food products during processing or storage of food animal origin products. The main types of food safety hazards are biological, chemicals, and foreign objects. This unintentional contamination of meat during the slaughter can be reasonably anticipated based on the type of processing. This principle is the foundation of the Hazard Analysis Critical Control Point (HACCP) process used to ensure food safety. Hence, implementing Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Standard Operating Procedures (SOPs) during slaughtering and processing is the 'need of the hour' to minimize the risk of contamination and produce high quality meat. Moreover, Sanitation Standard Operating Procedure (SSOP) documented steps that must be followed to ensure adequate cleaning and sanitizing of meat contact and non-product surfaces. Lastly, food defense program protects food including meat from causing harm to the consumer, including security procedures to mitigate intentional acts of adulteration. This review can help in understanding how these programs work and the importance of each in producing high quality and safe meat. As we hope these programs will be implemented in developing countries very soon.

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INTRODUCTION

Meat is rich in essential protein and valuable nutrients for human health. Despite these benefits, it is a favorable medium of microbial growth and transmission to humans **(Bughti *et al*., 2017)**. Potential food safety hazards associated with consumption of products of animal origin were including physical, chemical, and biological hazards. Physical hazards include foreign objects such as stones, bones, glass, metal, building material, etc. Such unwanted materials are aesthetically unacceptable and may cause physical and psychological injury to consumers. Chemical hazards include naturally occurring toxins, excessive residues of agricultural chemicals, intentional or accidental food additives, detergents, sanitizers, and other plant-associated toxic substances that may contaminate food. Biological hazards include those of bacterial, parasitic, viral and prion nature. Prions are transmissible particles, devoid of nucleic acid, which become aberrant proteins causing transmissible spongiform encephalopathy (TSE) **(Sofos and smith, 2009)**.

Foodborne pathogens are common public health hazards in both developed and developing countries regardless of their economic status and geographic locations **(Tegegne and Phyo, 2017).** The public health burdens of foodborne microbes are higher in developing countries **(Odeyemi, 2016)** due to poor food handling and sanitation practices, inadequate food safety laws, weak regulatory systems, lack of financial resources to invest in protective equipment, and lack of education for food handlers **(Tegegne and Phyo, 2017).** The foods intended for human consumption, especially animal-origin food is most hazardous unless the food safety principles are employed **(Aluko *et al*., 2014).** Since meat is a highly perishable food stuffs **(Bindu *et al*., 2012)** and the abattoirs and butcher shops are such labor-intensive working areas.

Bacterial pathogens are the major cause of food safety problems in terms of occurrence and number of individuals affected. Among others, common bacterial pathogens associated with meat and poultry meat products include *Campylobacter* spp.,

Salmonella spp., *Escherichia coli* O157:H7, *Staphylococcus aureus* and *Listeria monocytogenes* **(Andarge *et al*., 2019)**. In addition to discomfort, these foodborne pathogens sometimes cause death of susceptible individuals and their cost to national economies may be very high. Therefore, it is important to know the ecology and properties of these pathogens to develop procedures for their control and for enhancement of the safety of our food supply.

Meat contaminations from meat handlers' bodies, the hide of animals, the gastrointestinal system of the animals, and the meat processing environment are the common health risks for meat consumers **(WHO, 2018)**. The food handlers' poor knowledge about the food contaminants and good hygienic practices are the main factors for poor prevention and control practices of these contaminants **(Djéni *et al*., 2014; Sharif *et al*., 2013)**. The meat handlers, which include slaughterers, meat inspectors, transporters, meat processors, and butcher shop workers are expected to be knowledgeable on foodborne pathogens, temperature control, cross-contamination, and cleaning and sanitation activities **(Annor and Baiden, 2011)**.

Control of foodborne pathogens in food is based on the approaches of minimizing product contamination through good production and manufacturing practices, proper sanitation and hygiene, and application of decontaminating procedures; destruction of contaminants by processes such as heat or irradiation in some products; or, inhibition/delay of their growth and multiplication through food preservation methods such as refrigeration, freezing, drying, fermentation, acidification, pasteurization, chemical preservatives or combinations of these in the form of multiple hurdles **(OIE, 2019; Haileselassie *et al*., 2013).**

To produce safe and wholesome meat, meat slaughtering facilities must practice in accordance with food safety programs **(Taylor *et al*., 2022)**. Such programs include Hazard Analysis Critical Control Point (HACCP) **(USDA-FSIS, 1994)**, Good Manufacturing Practices (GMPs), Good Hygiene Practices (GHPs), Standard Operating Procedures (SOPs) **(Lawan *et al*., 2013)**, and Sanitation Standard Operating Procedures (SSOPs) **(Dawit *et al*., 2020)**. The knowledge and practices of the slaughterhouses and butcher shop workers about food safety are therefore very crucial to eliminate the emerging and re-emerging zoonotic microorganisms and to produce healthy and wholesome meat for consumers. Therefore, we aimed to describe and prioritize the different food safety programs and systems implemented in slaughter establishments worldwide to ensure that meat is produced safely for human consumption.

A food safety program is a written plan that shows what a business does to ensure that the food it sells is safe for people to eat. It is an important tool to help businesses safely handle process or sell potentially hazardous foods and maintain safe food handling practices to protect public health. A sample food safety program is a simple document that describes the steps required to ensure the safety of the food being sold. A template may be designed for use by different types of food businesses, or it could be designed especially for a particular type of food business **(Anonymous, 2022)**.

Hazard Analysis Critical Control Point (HACCP)

Basically, HACCP system is just the systematic application of good practice to the prevention of food safety problems and thus producing safe food. Prevention has two key elements: (1) anticipation of the problems and (2) design of the right preventive solutions. Prevention is active, not passive, in its approach. The HACCP system has been adopted worldwide by many foods manufacturing companies **(Khamisse *et al*., 2012).** HACCP attempts to guarantee food safety and harmlessness, it ensures the protection of products and the correction of failures which decreases the costs for quality defects and practically eliminates the need for final superior control. The beef carcass surface is readily subjected to various sources of contamination mainly, hides, dust, water, stomach, intestinal or any inedible materials derived in the slaughterhouse, in addition to, hands and clothes of the workers **(Craigie *et al*., 2012).**

In late May 1993, U.S. Department of Agriculture (USDA) Secretary Mike Espy directed USDA's Food Safety and Inspection Service (FSIS) to provide him with a plan for implementing mandatory HACCP in the nation's meat and poultry establishments. The Secretary recognized that such a system, which has been under study by FSIS, was a necessary building block of the inspection system of the future. In workshops held in 1991 and 1992, five generic HACCP models were developed and are being published for public information. The models should be useful for companies developing individualized plans **(USDA-FSIS, 1994).** There are seven principles of HACCP.

1. Identify health hazards

All hazards associated with each process step must be identified and enlisted. The most practical approach is first to construct a process diagram, with clearly defined individual process steps. All inputs, including raw materials at each step, must then be identified. Next, the hazards (microbial, parasitic, chemical, and physical) that could occur at each step are identified. The methods by which hazards are

transferred to the product are identified. Finally, any redistribution of hazards within/on the product is analyzed **(USDA-FSIS, 2018).**

2. Identify Critical Control Points (CCPs)

A Critical Control Point (CCP) is any point along the production process where hazards can be efficiently controlled. A decision tree is useful to clarify CCPs. CCPs are sometimes divided into two types: CCP1s and CCP2s, where CCP1s can control the hazard fully (e.g., carcass decontamination interventions), whilst CCP2s can only minimize the hazard, but do not afford complete control (e.g., hygiene of dressing, evisceration, etc.). In conventional slaughter and dressing processes, CCP1 controls are rare: some people even consider them as non-existent. Usually, the hazards cannot be eliminated at the slaughter line. Within the European Union (EU), where presently carcass decontamination is not allowed, most CCPs in slaughterhouse are actually CCP2s **(USDA-FSIS, 2018).**

3. Establish critical limits for each CCP

For each CCP, defined and measurable critical limits must be determined, below which the hazard is controlled, and the product is acceptable, and above which the hazard is not controlled, and the product is unacceptable. The critical limits must be easily visualized or measured. Within slaughter operations, a common and useful critical limit states that no visible fecal contamination is allowed at a particular step (e.g., after de-hiding or after evisceration). Other examples of critical limits on the slaughter line are that carcass refrigeration temperature is ≤7°C, and that the temperature of the hot water in the knife sterilizers is ≥82°C **(USDA-FSIS, 2018).**

4. Establish a monitoring system for each CCP

For each CCP, monitoring parameters must be established. Monitoring is often not continuous but must be regular and of known frequency. Sometimes monitoring is based on a sampling plan, but this must be meaningful. Clearly defined methods (e.g., visual, for absence of fecal carcass contamination) must be used to monitor the CCP by trained staff. The monitoring system must state clearly who is responsible if the CCP is found to be out of control **(USDA-FSIS, 2018).**

5. Establish corrective actions if CCP is out of control

For each CCP, specific actions are taken when critical limits are exceeded. For example, in the case of carcass contamination, trimming, or altering its disposition, may be conducted. These actions are designed to regain rapid control of the CCP (e.g., retaining carcass on the slaughter line) and to prevent reoccurrence of the problem (e.g., replace or retrain the staff) **(USDA-FSIS, 2018).**

6. Verify that the HACCP plan is working effectively

Each HACCP plan must be validated, i.e., analyzed to determine that all the controllable hazards have been identified and included in the plan. The plan is then analyzed thoroughly to ensure that it is complete and capable of achieving the company's performance objectives (POs), thus ultimately enabling achievement of the government's FSOs. Verification is conducted using measurable parameters and by comparing defined parameters with in-house and national performance; the aim is to verify that the plan is working and that all hazards are controlled **(USDA-FSIS, 2018).**

7. Establish documentation and records

HACCP documentation must be thorough and include all details of the HACCP plan. All monitoring, corrective actions, verification procedures and results must be recorded. The HACCP plan must be adhered to by all staff involved **(USDA-FSIS, 2018).**

Advantages and limitations of the HACCP-based system

HACCP is proactive and preventative, the aim being to anticipate problems and prevent their occurrence. It is owned by producers and staff, so compliance and participation are stimulated, and motivation is usually high. HACCP is also specific, systematic, and documented. These are all qualities that contribute to the effectiveness of HACCP-based systems in achieving hygienic production processes and, hence, a safe product (meat).

On the other hand, HACCP is demanding on staff and time. Developing, implementing and monitoring HACCP requires a team of experts in the plant, covering a range of disciplines (e.g., slaughter personnel, engineers, veterinarians, microbiologists, chemists, management). This is achievable by large operators with a workforce having all the necessary skills but is less achievable for small operators. Operators producing many products may also experience difficulty developing/implementing a separate HACCP plan for each. However, external organizations can be contracted to assist small operators to design the HACCP plans necessary for their plant; support can also be obtained from producers' associations. HACCP systems are designed to assure product safety, whilst the normal Quality Assurance systems operating in slaughterhouses are designed to reassure commercial clients about varying aspects of the product **(Veterian, 2017).**

Finally, the principles of HACCP cannot be implemented independently and must be supported by properly implemented pre-requisite programs (e.g., Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP). This section of the document assumes that these pre-requisite programs are in place and being implemented. This will highlight records that slaughterhouse management should maintain in order to prove that their HACCP system is operational i.e., through verification. It will also outline the potential CCPs that may be used in a slaughterhouse.

Good Manufacturing Practices (GMPs)

Good Manufacturing Practices (GMPs) are the basic operational and environmental conditions required to produce safe meat. GMPs for slaughterhouses and meat cutting plants is established to provide practical guidelines recommended for processing animals and their products in slaughterhouses to ensure the productions are safe for human consumption. GMPs address the hazards associated with personnel and environment during meat production. They provide a foundation for any food safety system. Once GMPs are in place, processors can implement a Hazard Analysis Critical Control Point (HACCP) system to control hazards that may affect the slaughtering as well as product-handling for ruminants, pigs, and poultry **(Keener, 2009).**

Cross-contamination of food-by-food handlers is the most frequent cause of contamination. Employee hygiene is essential, because the hygienic condition and habits of workers determine the amount of cross contamination from worker to food products. It cannot be overemphasized that clean, sanitary workers are necessary to produce clean, sanitary food products. Examples of personal hygiene include washing hands, removing jewelry, and maintaining personal cleanliness. Also, the food processor should provide training for new employees in personal hygiene based on GMPs, and that training should be part of a formal, written training program that consists of instruction in proper handwashing, personal cleanliness, and sanitary hygiene **(Suryanto** et al**., 2019).** GMPs Address:

- Environmental control (premises): location, design, and construction of the building and its interior, equipment, and water supply.
- Personnel practices: personal hygiene, hand washing, clothing/footwear/headwear, injuries and wounds, evidence of illness, access and traffic patterns, and chemical use.
- Shipping, receiving, handling, and storage: inspection procedures for transport vehicles; loading, unloading and storage practices; inspection procedures for incoming products; shipping conditions; returned and defective products, allergen control; chemical storage; waste management.
- Pest control: monitoring procedures for the exterior and interior of the building (ex: surveillance, fumigation) and the use of pesticides.
- Sanitation: cleaning and sanitizing procedures and pre-operational assessment.
- Equipment maintenance: procedures describing preventive maintenance and calibration of all the equipment and instruments that can affect food safety (ex: thermometers, thermocouples, metal detectors, scales, pH meters).
- Recall and traceability: procedures that ensure final products are coded and labelled properly; incoming materials; in-process and outgoing materials are traceable; recall system is in place and tested for effectiveness (ex: procedures for mock recalls).
- Water safety: water safety monitoring procedures for water, ice, and steam, and water treatment procedures that ensure it is potable for use in food processing **(Keener, 2009).**

GMPs have two main components: written programs and implementation. Both are essential for the success of food safety system. Written programs are all the policies and procedures required to meet the standards listed in each GMP program. These include policies and procedures (e.g., standard operating procedures (SOPs) and sanitation standard operating procedures (SSOPs)).

Good Hygiene Practices (GHPs)

It's important to work towards promoting good hygiene management in your food supply chain. To do this, you should be auditing your supply chain processes. GHP compliance covers the minimum hygiene and sanitary practices. It highlights areas of concern and potential pitfalls to improving your food safety standards. The auditing will check your facilities, equipment, and workspaces to ascertain what needs to improve and potential risks. It will assess and ensure the food being processed is suitable for human consumption. Food contamination and disease should not be taken lightly, and GHP compliance will aid in that consideration **(ADAFSA, 2019).**

Food can become contaminated at any stage during food production, including at the farm, during slaughter and processing, or during storage and delivery. According to the Codex Alimentarius Commission, GHPs refer to all practices regarding the conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain from primary production through to handling of the final product **(Wambuia *et al*., 2017).**

The purpose of GHP is to

- Prevent illness/injury caused by food consumption.
- Assure the food is suitable for human consumption through guidance on its principles.
- Increase the knowledge of food safety within the whole food supply chain by providing health education programs.

Examples for GHPs at slaughterhouses

- GHP for skinning: Prevent contact of the dirty parts of the hide with meat surface. Prevent contamination of the carcass with dirty hooks, knives and protective clothes. After the initial cut through the skin, sterilize the knife in water at 82°c and then make all other cuts from the inside out.
- GHP for evisceration: Do not puncture the viscera (alimentary tract), uterus, urinary bladder and gall bladder during separation cuts. Prevent contact of viscera with floors, walls or stands. Regularly wash hands/aprons and sterilize knives, especially after any possible contamination has occurred **(Wambuia *et al*., 2017).**

GMP and GHP describe the requirements for hygienic design and construction of slaughterhouse premises and equipment. It is a combination of quality procedures and is described by Standard Operating Procedures (SOPs). SOPs are aimed at ensuring that carcasses are consistently produced to their specifications i.e., minimizing microbial, chemical, and physical contamination **(Brown, 2000).** GHP describes the basic hygienic measures which management should have in place i.e., Sanitation Standard Operating Procedures (SSOPs). SSOPs describe how GHP is to be achieved. All prerequisite programs should be documented, regularly audited, reviewed periodically and modified when necessary. As a general rule, prerequisite programs are managed separately from HACCP plans, however, sometimes there may be certain parts of prerequisite programs that are integrated into a HACCP plan **(Anon, 1997b)** Figure 1.

Standard Operating Procedures (SOPs)

A standard operating procedure (SOP) is a step-by-step, repeatable process for any routine task. It's a kind of documentation that prevents stress, mistakes, and miscommunication. SOPs ensure reliability, efficiency, and consistently hitting quality standards in regular work activities. SOPs are included under GMP; however, they differ slightly as SOPs may or may not be related to the safety of carcasses. For example, the SOPs for handling cattle in the lairage before slaughter would not directly affect food safety, while the SOPs for the safe removal of bellies from carcasses on the slaughter line relate directly to food safety **(DEFRA, 2015).**

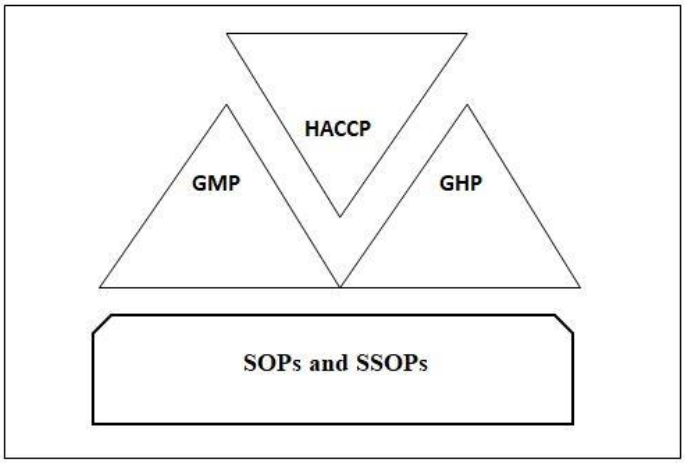

Fig. 1: GMP and GHP are prerequisite programs for HACCP, and SOPs with SSOPs are prerequisite for GMP and GHP

Standard Operating Procedures (SOPs) are established methods that are followed routinely for the performance of designated operations within the slaughterhouse. Current guidelines recommend that management should have documented SOPs. Slaughtering SOP relates to the use of restraining boxes for slaughtering livestock without the use of stunning. The slaughter process can have implications for both animal welfare and carcass quality. Slaughtermen need to be able to recognize and solve problems of poor bleeding. Procedures cover the following processes:

1. Inspection and preparation of the restraining device.
2. Moving animals into position with minimum stress.
3. Reducing animal handling.
4. Restraint of the animal for slaughter.
5. Performing effective slaughter.
6. Recognizing and rectifying problems with bleeding.
7. Recognizing brain death **(MLA, 2012).**

Sanitation Standard Operating Procedures (SSOPs)

SSOPs are written procedures that describe appropriate procedures used before production i.e., pre-operational sanitation and during production i.e., operational sanitation. SSOPs may include the cleaning, sanitizing, and disinfecting of production equipment and slaughterhouse environment at breaks and / or between shifts. Management should maintain these written procedures on file, and they should be available upon request. It is management's responsibility to implement the procedures as they are written in the SSOPs. If management determine that the SSOPs fail to reduce contamination, they should

implement corrective actions and include measures that prevent recurrence **(USDA-FSIS, 2019).**

The slaughter establishment has the responsibility to develop written SSOPs that clearly describe procedures the establishment will implement to prevent direct contamination or adulteration of product. The establishment and inspection personnel should understand that there are not separate SSOPs for different operations or different shifts. The SSOPs cover the entire establishment and all shifts of operation.

These written procedures must

- Contain all the procedures the establishment will conduct daily, before and during operation.
- Identify the procedures to be conducted prior to operations (pre-op) and address, at a minimum, the cleaning of food contact surfaces of facilities, equipment, and utensils.
- Specify the frequency with which each procedure in the SSOP is to be conducted and identify the establishment employee or position responsible for the implementation and maintenance of the procedures.
- Be signed and dated by the individual with overall authority on-site or a higher-level official of the establishment. This signature signifies that the establishment will implement the SSOPs as written and will maintain the SSOPs in accordance with the requirements of this part **(USDA-FSIS, 2019).**

How do we monitor and record operational sanitation practices during slaughter?

The slaughter manager is responsible for ensuring that employee hygiene practices, sanitary conditions and cleaning procedures are maintained during the slaughter day. Make a visual observation at least once between each break in work. Record results on the SSOP Inspection form at least once per slaughter day. If an inspected action is being done, mark the appropriate symbol (✓). If a deviation is noted, mark the (X) symbol in the SSOP Inspection form, and then describe the problem and the corrective actions taken to fix it on the Corrective Action Log **(Wickford, 2007).**

Pre-Operational (to be monitored daily before start-up)

- Slaughter area product-contact surfaces are in good order and are cleaned and sanitized after operations.
- Processing area product-contact surfaces are in good order and are cleaned and sanitized after operations.
- Equipment and facilities that are potentially indirect food-contact surfaces are clean and in good operating condition.
- All cleaners, sanitizers, pesticides, and other potentially toxic chemicals are properly labeled and stored separately from food and processing areas.
- Rodent traps are loaded and properly located; entryways prevent rodent entrance.
- Food containers, packaging, and dry storage areas are maintained to prevent direct or indirect contamination of food.
- All food transport equipment is clean and in good repair.

Operational (to be observed at least once between every break in work and recorded at least once daily)

- No person with illness, or open/infected wounds is allowed to handle foods or food-contact surfaces.
- Employees do not wear jewelry (other than secured wedding bands) or cosmetic items that could contaminate products.
- Employees are wearing clean garments, gloves and hair covers (as necessary for assigned tasks).
- Food, beverages, and medications are stored in designated employee lockers or storage areas.
- Employees wash hands properly after using bathroom or handling objects that may contaminate products.
- Employees do not use tobacco, eat, or drink in slaughter or production areas.
- Hand wash facilities and toilets are in good supply and functioning correctly.
- Tools, hands, aprons, and boots are cleaned and sanitized (if appropriate) to prevent contamination during evisceration or during processing of skinned carcasses.
- Brisket saw is rinsed and sanitized before next use.
- Tools that have potentially contacted specified risk materials (SRMs) are cleaned and sanitized before next use.
- Appropriate scheduling, separation, and/or cleaning/sanitizing procedures are used to prevent cross-contamination with allergens.
- Dry and wet waste materials are properly contained and removed from the processing area. No accumulation of waste materials.
- Ready-To-Eat foods are handled and stored such that they are separated or segregated from raw foods, raw food containers and packaging.
- Work surfaces are cleaned and sanitized between handling different foods, or between raw and Ready-To-Eat foods.

- Condensation is removed from process areas in a sanitary manner **(Wickford, 2007).**

Food Defense Program

Food defense is not the same as food safety. Food defense focuses on protecting the food supply from intentional contamination, with a variety of chemicals, biological agents or other harmful substances by people who want to do us harm. Food defense is also protecting the food products from adulteration intended to cause public health harm or economic disruption which is unlike HACCP plan where it prevents unintentional hazards. The food system within the United States continues to increase in complexity, diversity, and reliance upon interconnected domestic and global systems. Concurrently, the threat landscape and potential sources of intentional adulteration continue to evolve and increase in complexity, which could ultimately have a powerful impact on public health and the economy **(Davidson *et al*., 2017).**

Intentional adulteration may take several forms, such as acts of terrorism, tampering by discontented employees, consumers, or competitors, as well as economically driven adulteration **(Bogadi *et al*., 2016)**. There are countless ways of causing intentional harm, both to the consumer and to an industrial unit, and, although uncommon, these actions can have serious consequences. Intentional adulteration incidents have been recorded at every major point along the farm-to-fork continuum: pre-harvest, processing, transportation, retail, and at the consumer level **(Fredrickson, 2014).** From 1950 to 2008, a total of 729 confirmed incidents were reported in the literature. Still, there is limited research, and publications on food defense at the food business operators' level are scarce **(Manning, 2019).**

Akin to HACCP, Threat assessment and critical control point (TACCP) and Vulnerability assessment and critical control point (VACCP) are HACCP based program that deals with threats (food tampering, intentional adulteration of food, and food defense) and vulnerability (food fraud) respectively. TACCP is also known as food defense, and it helps to protect food from behaviorally or ideologically motivated deliberate contamination. In VACCP, food fraud is economically motivated **(Gadekar *et al*., 2021).**

The aim of TACCP and VACCP

Both TACCP and VACCP use the same risk management approach but there are subtle differences between the two. Threat assessment and Critical Control Point (TACCP) helps food producers identify weak points in their supply chain and processing activities that maybe open to intentional and malicious attack. The TACCP protocol focuses on tampering, intentional adulteration of food and food defense **(Soon *et al*., 2019).** Vulnerability Assessment and Critical Control Point (VACCP) focuses on food fraud as well but widens. TACCP/VACCP should be used as part of a broader risk management process or as a way of starting to assess risks via a systematic approach. TACCP/VACCP, if employed correctly, can help an organization:

1. Reduce the likelihood of a deliberate malicious attack.
2. If an attack occurs reduce the impact on a business of that attack.
3. Protect an organizations reputation.
4. Reassure customers that the organization is managing appropriately the risks in the supply chain and demonstrate due diligence.
5. Demonstrate that reasonable precautions are in place to protect food supply chain.

A Food defense plan will help you maintain a safe working environment for your employees, provide a quality product to your customers, and protect your bottom line.

CONCLUSIONS

During meat production from farm to fork, critical control points need to be identified, monitored, and ensured that safe produce is generated. To achieve food safety, different programs should be implemented, such as HACCP, GMP, and GHP. These requirements particularly relate to quality assurance of the production processes and the production environment, as well as the analysis of possible risks to food safety. So, it is necessary to have a strong quality management system for food safety. GMP and SOP are two tools that help to produce high-quality and safe meat and meat products. SSOPs include the cleaning, sanitizing, and disinfecting of production equipment and slaughterhouse environment at breaks and / or between shifts to prevent direct contamination or adulteration of products. Whereas food defense is protecting the food products from adulteration intended to cause public health harm or economic disruption and it helps to protect food from behaviorally or ideologically motivated deliberate contamination. The stakeholders including butchers, slaughterhouse personnel, and consumers need to be educated about the importance of hygiene in safe meat production. Food safety is a collective responsibility and strict implementation of regulatory guidelines during all stages of food production will ensure safe meat and meat products to consumers.

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