

Actions of military veterinary medicine in a food defense context: a study under the perspective of the Brazilian Armed Forces based on American Armed Forces guidelines

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Abstract

The perception that food supplies and any stage of manufacturing process chains can become vehicles for the intentional spread of biological, chemical, physical, and radiological contaminants took form after the September 11, 2001, attacks in the United States. Food defense thus emerged as a new area within the food safety field. Under this perspective, risks to food and food production chains originate from intentional and ideologically engineered acts that aim to harm public health on a wide scale. In times of international conflicts that aim to destabilize a nation's morale, the armed forces may become a target for attacks, leading to operability losses and momentary or permanent troop losses due to foodborne illnesses or deaths caused by the massive contamination of food consumed by the military. In this regard, veterinarians enrolled in the armed forces can focus on defense measures against deliberate food supply contamination, as they are trained in food technology, inspection, and surveillance. This review summarizes the role of veterinarians in the food defense field in the United States Armed Forces and the current situation of these professionals in the Brazilian Armed Forces.

Keywords: safety, food safety; biological contaminants; foodborne diseases; bioterrorism.

Practical Application: After the 2001 attacks, food defense emerged within the food safety field in the USA. Food defense aims to constantly monitor food and beverages for intentional contamination. Military troops can be the target of food contamination, destabilizing a country's sovereignty. The USA Armed Forces have a skilled team of veterinarians working in food defense and the Brazilian Armed Forces could rely on USA expertise to evolve in food defense.

1 INTRODUCTION

Food safety is increasingly perceived and desired by consumers (Andrade et al., 2021). According to the Codex Alimentarius, a safe foodstuff is able to protect the health of those who consume it (FAO, 2022) and should, therefore, be free from biological, physical, or chemical hazards (FAO, 2003). Different methods, techniques, processes, and equipment must be adopted to minimize or prevent food and beverage contamination through unintentional acts, resulting in food safety (Lima, 2020). The prevention of intentional food contamination is carried out by food defense actions, which are widely discussed in countries targeted by terrorist attacks. This type of action began in the USA and represents the sum of actions and activities associated with the prevention of extremist acts and criminal acts concerning food contamination, jointly defined by the Food & Drug Administration (FDA), the United States Department of Agriculture (USDA), and the Department of Homeland Security (DHS) as activities associated with protecting the food supply chain against intentional adulteration or contamination acts, such as bioterrorism (IFS, 2014). Purposeful and criminal food and beverage contamination due to ideological issues can, in fact, destabilize the social, economic, or political order of a nation (Figueira, 2018; Severino & Almeida, 2021).

The bioterrorist attacks suffered by the USA on September 11, 2001, led to the deaths of five people due to anthrax spore exposure, demonstrating how vulnerable nations can be when it comes to intentional contamination acts (Andrade et al., 2021; Lima, 2020), where criminals rely on a country's lack of preparation and training (Abreu et al., 2020). In fact, the USA has identified intentional food chain contamination routes (Lima, 2020), and the World Health Organization (WHO) recognizes that terrorist attacks can turn food and beverages into weapons through deliberate contamination, comprising one of the greatest health threats of the 21st century (Cavalheiro et al., 2021).

In this context, this study aimed to contextualize the role of veterinarians in the surveillance, control, and detection of possible attacks where food and water are used as vehicles for biological, chemical, and radiological agents, also specifying food defense actions carried out exclusively by veterinarians in the USA Armed Forces and the current situation of the armed forces of Brazil in this regard.

2 MATERIALS AND METHODS

An integrative review (Barros & Lima, 2020) on this subject was carried out in 2022 based on a keyword search in the PubMed database. The articles that most adhered to the

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proposed theme were selected. The search was complemented through the Google search site, and only relevant scientific results were selected, in addition to documents and reports from official bodies. The following keywords in English were used: “food defense,” “armed forces,” “military forces,” “terrorism,” and “veterinary,” used alone or in combination.

3 RESULTS

3.1 The beginning of food defense

“For the life of me, I cannot understand why the terrorists have not attacked our food supply because it is so easy to do.” Tommy Thompson, former Secretary of Health and Human Services (U.S. Government Publishing Office, 2005).

After the September 11th attacks, the USA’s DHS was established in 2002, comprising 22 different federal departments and agencies with the mission of “developing and coordinating the implementation of a comprehensive strategy to protect the USA from terrorist threats or attacks” (Abreu et al., 2020; Caruso, 2002). In the same year, the Public Health Security and Bioterrorism Prevention and Response Act was issued, granting the USA FDA powers and resources to better control the country’s food supply and directly interfere in agricultural and food product import and export dynamics, defining the risks and possibilities of food contamination terrorist attacks (Peixoto & Melo, 2019).

This led to the implementation of the food defense concept, comprising a set of practices and procedures adopted to guarantee food and beverage safety from intentional and malicious adulteration or contamination promoted by ideologically motivated attacks aiming at supply contamination or interruption (BSI Standards Limited, 2017; FDA, 2022). In this regard, intentional contamination can take place through biological, chemical, and physical agents, which can often be identified by food safety practices; through contamination involving radiological or genetic agents that are difficult to detect (Joint Chiefs of Staff, 2020), or through still-unknown biological and chemical agents (BSI Standards Limited, 2017; Manning & Soon, 2016).

Difficulties in attributing the occurrence of a foodborne disease to a criminal event are, however, noted. For example, in one instance, a religious sect in Oregon (USA) contaminated the salad bars of a restaurant chain with *Salmonella typhimurium*, the bacterium that causes salmonellosis, in 1984. As a result, 751 people suffered gastrointestinal infections. The event, however, was not considered criminal until 1 year after the attack, through the testimony of a sect deserter (Abreu et al., 2020; Mara & McGrath, 2012; Peixoto & Melo, 2019).

Several food-related factors make intentional food contamination, fortunately, difficult to carry out. One of these comprises the low “publicity” of food contamination in the face of more radical and immediate attacks, such as bombings. Another is the fact that food preparation, such as washing and cooking, among others, can inactivate many contaminants. In an attempt to circumvent this, intentional contamination is often carried out in finished products, with 98% of food attacks taking place at marketing points, at home, or in workplaces (Mara & McGrath, 2012).

Another very effective food attack form consists in intentional agriculture and livestock contaminations at the end of production chains, with agroterrorism, which targets primary production, considered a food terrorism subset (Jurica et al., 2021). Reports of crop or herd contamination, mainly by biological agents, are not uncommon, leading to considerable agribusiness losses. In the USA, agroterrorism concerns generated a report directed to the DHS, establishing the defense of the food, agriculture, and veterinary sectors from terrorist attacks by the Countering Weapons of Mass Destruction Office (CWMD) (Department of Homeland Security, 2020; Peixoto & Melo, 2019). In Brazil, a probable case of agro-terrorism took place in the state of Bahia in 1989, where the fungus *Crinipellis pernicioso* (Stahel) Singer fungus, popularly known as Witch’s Broom, was introduced into the second largest cocoa plantation in the world in Southern Bahia, probably motivated by political issues, leading to the unemployment of local workers, who then became dependent on federally funded stipends (Caldas & Perz, 2013).

3.2 Food defense in a military context

Intentional food and beverage contamination can be a strategy to attack a country’s sovereignty, affecting the physical and mental health of entire military contingents. In conflict or terrorist situations, food and beverage poisoning and supply breakdowns can and have already been employed as weapons against active troops (Severino and Almeida, 2021), leading to irreparable consequences (Abreu et al., 2020), such as decreased military capacity and combat power due to temporary or permanent casualties (Peixoto & Melo, 2019).

According to the U.S. Department of Defense (DoD), military personnel are twice as exposed to food insecurity risks compared to the national average (Cronk, 2021). Several reports on intentional contamination by chemical, biological, radiological, or nuclear agents targeting military personnel are, in fact, available. For example, the Japanese Armed Forces tested food as a vehicle for pathogenic microorganisms during World War II, including *Vibrio cholerae*, *enteric Salmonella serovar Paratyphi*, *Shigella* spp., and *Yersinia pestis* (Hennessey & Busta, 2014). In another report, several “Islamic militants” were arrested in 2003 for conspiring to poison food at a British military base, and in 2006, approximately 400 Iraqi police officers suffered food poisoning, although no deaths were noted and whether the act was unintentional or not is still not clear (Mara & McGrath, 2012).

Apart from the low prevalence of intentional contamination cases in the military, available reports regarding food disorder symptoms, mainly diarrhea caused by different opportunistic microorganisms as a consequence of precarious hygienic-sanitary military facility conditions in times of war, point to the risk of deliberate food chain contamination vulnerabilities, including water and food reservoirs (Abreu et al., 2020; Lima, 2020; Peixoto & Melo, 2019). In this context, the forces who control food and water on the battlefield, especially during protracted conflicts, ultimately prevail (Norton, 2020).

3.3 Food defense as a veterinarian field

Veterinary medicine goes beyond animal health, also contributing to human and environmental health (Anjos et al., 2021). In fact, veterinary medicine schools were created in the 18th century aiming at the practice of public health efforts, when attention was focused on the control of herd epizootics and reducing human health risks due to indiscriminate animal slaughter for human consumption (Pfuetzenreiter et al., 2004; WOAAH, 2022b). Professional veterinarian evolution has demonstrated the importance of these professionals in the food safety field, which has increasingly incorporated them into roles concerning food production efficiency and the quality of food products of animal origin that reach final consumers (WOAH, 2021).

The term “Veterinary Public Health” was established in 1946 during the first WHO/FAO meeting (Rosen, 1994 *apud* Frias, 2009), defined as follows: “*Veterinary public health comprises all community efforts that influence and are influenced by the veterinary medical art and science applied to the prevention of disease, protection of life, and promotion of human welfare and efficiency*” (WHO, 2002).

In Brazil, veterinary medicine advances in the public health field were set by Law 5.517 (Brasil, 1968), which established the veterinarian professional exercise. This law defines exclusive veterinarian competences, including several public health activities, i.e., the inspection of food products of animal origin and the sanitary, hygienic, and technological supervision of meat packing plants, slaughterhouses, food processing plants, and food factories. In addition, the technical and scientific knowledge conferred by this academic degree also allows veterinarians to perform other functions not usually attributed to this profession, such as Food Hygiene and Quality program implementation, administration, planning, and coordination (Pfuetzenreiter et al., 2004).

Food contamination incidents comprise a significantly serious issue regarding the food supply chain, and veterinarians are apt in sanitary food protection, with the need for the presence of these professionals throughout the entire production animal product chain, i.e., “from farm to fork,” being noted as inescapable (Anjos et al., 2021).

Regarding food defense, veterinarians are also clearly able to guarantee criminal contamination mitigation, especially in the case of biological agents. In this regard, approximately 60% of human infectious diseases are of animal origin (WHO, 2022), like *Salmonella*, *Campylobacter*, and enterohaemorrhagic *Escherichia coli*, some of the most common foodborne pathogens that affect millions of people every year, sometimes with serious and fatal outcomes. Furthermore, approximately 80% of the pathogens employed in bioterrorist acts are estimated to be of animal origin (Pal et al., 2017). Finally, veterinarian approaches to food defense are also in line with the One Health concept proposed by the WHO, WOAAH, and FAO, which recognizes the close link between animal, disease, environmental, and human health, as well as the inherent risk of consuming foodstuffs contaminated with zoonotic agents (WOAH, 2022a).

The role of veterinarians within the armed forces should be no different, as, besides protecting the health of armed forces dogs and horses, veterinary medicine is also extremely useful in preventing and maintaining troop health through health surveillance and food and water inspection activities. Furthermore, attention has increasingly turned to terrorist attacks and biological, chemical, and radiological threats in a globalized world, especially after September 11th, when country food production chains can become terrorist targets. The armed forces must, therefore, employ constant surveillance, and the technical-scientific knowledge veterinarians may offer is paramount in the biosecurity and defense against chemical, biological, radiological, and nuclear agents in the three armed forces (Navy, Army, and Air Force) (Leal, 2017).

3.4 The food defense role of veterinarians in the USA Armed Forces

According to Army Health System Support Planning (ATP 4-02.55), the mission of the U.S. Army Veterinary Corps is to execute veterinary service support essential for Force Health Protection and Health Service Support. Thus, the mission of the Army Veterinary Corps in the USA Army Public Health Center Corps (USAPHC) is to provide Veterinary Public Health services, with the board of veterinarians playing a leading and active role in food defense. It is important to note that the U.S. Army Veterinary Corps is a medical branch of the U.S. Army Medical Department (AMEDD), established in 1916 (U.S. Army, 2022).

The army is responsible for providing veterinarians who assist the DoD (Department of Defense, 2013), as well as other national agencies, such as the Federal Bureau of Investigation (FBI), the Central Intelligence Agency (CIA), and FDA (ATP 4-02.7/MCRP 4-11.1F/NTTP 4-02.7/AFTTP 3-42.3, 2016), whenever required (Army Regulation 40-905).

Each Army facility has a Food Defense Assessment Team (FDAT), which is responsible for assessing food vulnerabilities and conducting annual facility inspections. The Army FDAT also advises other military services concerning food defense plans and is responsible for the annual food vulnerability assessments of all Army and Navy installations (Abreu et al., 2020; Mara & McGrath, 2012). The Air Force, however, has its own Food Inspection Program (ATP 4-02.7/MCRP 4-11.1F/NTTP 4-02.7/AFTTP 3-42.3, 2016; U.S. Army, 2013).

Food defense actions carried out by the veterinary corps also include constant surveillance regarding deliberate food and water contamination with chemical, biological, radiological, or nuclear weapons/agents. Thus, according to the joint manual for the Army, Navy, Air Force, and Marine Corps, FM 4-02.7/MCRP 4-11.1F/NTTP 4-02.7/AFTTP 3-42.3 (United States, 2016), military veterinary personnel are responsible for food and water surveillance from origin to consumption, as well as in dining facilities, carrying out food screening and microbiological laboratory analyses, among other responsibilities (Barros & Lima, 2020).

3.5 The current veterinarian food defense reality in the Brazilian Armed Forces

Food safety became formally considered in Brazil in 2015, when the Armed Forces Food Safety Regulation was published

(Brasil, 2015). This regulation (MD42-R-01) establishes essential Good Practices and Standard Operating Procedures requirements, in addition to sanitary food control (Peixoto & Melo, 2019). Chapter IV, concerning food defense, was added in 2018 to the Brazilian Food Safety Regulation (Lima, 2020). It does not, however, address specific methodologies for the implementation of an Armed Forces Food Defense plan (Abreu et al., 2020), and no veterinarian role in promoting food safety actions is mentioned.

Based on the Armed Forces Food Safety Regulation, the Brazilian Army structured its Food Safety Audit Program, where auditors trained by the Army's Supply Board audit the quarter kitchens where collective meals are produced, certifying that the applied Good Manufacturing Practices are in accordance with over 85% of the required checklist (Lima, 2021). The Brazilian Air Force acted similarly, implementing an external food safety audit program (Lima, 2021).

The Brazilian Air Force Pirassununga Farm represents another veterinarian public health, technology, and product of animal origin inspection field in Brazil. This comprises an agricultural establishment that produces foodstuffs with the purpose of supplying military and civilian Air Force personnel and their families (FAB, 2022). The farm is composed of swine, beef, and dairy sections and is staffed by five veterinarians, in addition to a Ministry of Agriculture, Livestock and Supply, Federal Inspection Service Federal Agricultural Inspector.

Concerning the Brazilian Navy, only one veterinarian is active in the food safety area of this armed force, stationed at the Navy Intendency Supplies Depot in the state of Rio de Janeiro (Depósito de Suprimentos de Intendência da Marinha no Rio de Janeiro, DepSIMRJ) (Marinha do Brasil, 2022). This professional is responsible for the inspection of all animal products acquired for the supply of Navy organizations throughout the country.

Food safety appears as a concern within the scope of the Brazilian Ministry of Defense, cited in the "Health Support in Joint Operations" MD42-M-04 Manual (Brasil, 2017). This document raises concern and the need to prevent diseases transmitted by water or food in countries with high contamination risks and also mentions veterinarians as playing a vital role in protecting the armed forces health through food inspection actions.

More recently, aiming at strengthening the food defense theme in the Brazilian Armed Forces, the Ministry of Defense Head of Logistics and Mobilization instituted a Food Defense Working Group composed of Ministry of Defense and Army, Navy, and Air Force technicians, including veterinarians, nutritionists, and pharmacists specialized in food safety and nutrition (Lima, 2021). The first meeting took place on November 9, 2018.

On July 5, 2019, Brazil's Normative Ordinance No. 46/GM was published (Ministry of Defense) (Brasil, 2019). This document establishes the abilities of the Armed Forces Food Studies Commission (CEAFA), such as the development of protocols for the adoption of food safety and defense measures throughout food supply chains in times of peace or conflict. The CEAFA was instituted by Normative Ordinance

No. 456, Ministry of Defense, in early 2003 (Brasil, 2003). Both documents explicitly state the role of military veterinarians as important actors in the Commission concerning these attributions. It is, however, important to note that, until now, no strict food defense actions have been implemented by any Brazilian military organization, although this is planned for 2024 (Abreu et al., 2020; Lima, 2021).

4 DISCUSSION

A country's defense and security are the responsibility of its armed forces, and military health must be guaranteed for these actors to effectively fulfill their duties. In this regard, the quality and safety of the food supplied to military troops ensure their physical and mental health and the consequent fulfillment of obligations and orders inherent to military positions.

To the same extent that a country's food production chain can become the target of terrorist attacks, the armed forces may also become targets themselves. Because of this, food supply chains must undergo constant vigilance concerning the protection of the food supplied to the military, both in military organizations and those deployed on missions.

Following the September 11th terrorist attacks, the use of food as a deliberate contamination vehicle by biological, chemical, physical, or radiological agents has become significant, as this can be specifically directed at military troops. Thus, food safety has become an issue to be considered by food production chains worldwide, focusing on food defense, which includes protection against malicious attacks.

Concerning food products of animal origin, veterinary medicine was born out of the need to control the production of animal diseases in the field, focusing on zoonotic diseases and the control of epizootic cases. Subsequently, veterinary services were extended to slaughterhouses to maintain hygiene and implement quality control for food products of animal origin. Veterinarians now also play essential roles in the sanitary inspection of industrial meat, milk, eggs, and honey. These professionals may also be responsible for the application of control systems, risk management assessments, and other quality assurance actions required for the processing and distribution of food products of animal origin (WOAH, 2022a). Their role in public health efforts is, therefore, very clear, ensuring that food products of animal origin are free of infectious agents and contaminants, aiming for assured safety and quality intake by consumers.

The importance of Veterinary Public Health was recognized by the World Health Organization in 1946. In Brazil, the private competences of veterinarians in public health actions, including hygienic and technological aspects of products of animal origin, were established by Law 5,517 in 1968, and the recognition of veterinarians as health professionals by the Brazilian National Health Council (CNS) was affected in 1998. However, most Brazilians still do not recognize veterinary professionals as important public health agents. This scenario seems to reflect on the performance of these professionals in the Brazilian Armed Forces, especially when considering the American Armed Forces as a reference.

The Brazilian Army is the only one among the three armed forces that retains veterinarians as both career officers and temporary military personnel, currently totaling about 240 professionals. Meanwhile, the Navy and Air Forces still employ an extremely limited number of veterinarians, averaging only 10 and 25 temporary officers, respectively, who can only remain in the armed forces for, at most, 8 years. This short period of time does not allow for any type of career progression, also limiting a solid and satisfactory performance in the food safety and food defense fields and making surveillance actions, which should be permanent, unfeasible.

Veterinarians have more opportunities to work in food safety in the Brazilian Army, which offers more positions in this field, including food inspection, food safety, sanitary control of water and food (public health), sanitary, environmental, and epidemiological surveillance, zoonoses control, and in Chemical, Biological, Radiological and Nuclear Defense (CBRN Defense).

However, despite the importance of veterinarians in public health efforts, these professionals are not included in the Army's Health Corps. This may be a limiting factor for the greater recognition of veterinarians as public health agents within the armed forces, also limiting the development of clearer food defense policies. In fact, an effective food defense program has not yet been implemented against intentional attacks, and the subject is restricted to the Food Safety Regulations Food Defense chapter published by Brazil's Ministry of Defense. Another limiting factor for the food safety and food defense evolution within the armed forces is the lack of interoperability between the forces.

Fortunately, it seems that the Brazilian Food Defense scenario is changing in recent years, thanks to Army veterinarian initiatives seconded by the Ministry of Defense, exemplified by the recent creation of the Food Defense Working Group, which aims to develop an Armed Forces Food Defense Regulation, consolidating food defense within the armed forces (Lima, 2021). Another important initiative is the Ministry of Defense's approach to civil society, for example, in the form of a technical cooperation with the University of Brasília (UnB), established in 2023, which intends to strengthen food defense in the armed forces through food defense research. The first Food Defense Workshop was also held in 2023 at the Ministry of Defense headquarters in Brazil's capital, Brasília, with the participation of military personnel, strategic defense companies, universities, and NATO representatives, among others. This comprised the initial milestone for the development of the food defense concept in the armed forces, accompanied by the dissemination of the recently approved Food Defense Regulation (MD-R-02), the result of the working group established in 2018, whose implementation in military organizations is expected for 2024.

5 CONCLUSION

The adequacy of the Brazilian Armed Forces in their quest to improve the quality of food supplied to their troops is clear. Likewise, food surveillance actions are gaining relevance in the Brazilian Ministry of Defense, given the implementation of

guidelines and novel veterinarian food defense fields of action. Food surveillance and inspection actions in the Brazilian Armed Forces seem to follow the American Armed Forces pattern, with the Army instructing the other forces in the implementation of good practices and self-control programs. This may be due to the larger veterinarian contingent in the Army, which also acts as career officers, providing more time for the planning and implementation public health actions.

Veterinarians have much to contribute to the Brazilian Armed Forces in a food defense context, as veterinary training includes knowledge in the microbiology, epidemiology, hygiene, and technology fields concerning food products of animal origin and zoonoses, among others, making veterinary medicine one of the most specialized professions, including in a public health scenario. The recently developed Ministry of Defense Food Defense Regulation intends to implement guidelines in the Brazilian Armed Forces, with veterinary medical officers as protagonists, meeting the current need for constant food surveillance in a globalized world susceptible to attacks from any global location.

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