

Review on Role of Veterinary Service in Food Safety of Animal Origin

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Veterinary Service is a service, which provided by the veterinarians with the aim of monitoring and avoiding animal disease including zoonosis and keeping animal welfare. The production of safe animal products that will in turn protect the consumer necessitates, the integration of all processes of production from the farm level, through slaughtering, food processing, storage, transport, distribution, sale, cooking and serving of food in hygienic manners. Veterinarians are present at every link in the chain and have the knowledge and expertise to audit the standards of animal health, animal welfare and public health from “stable to table”. Safe food can only be produced if healthy, clean, residue free and stress free animals are delivered to the slaughterhouse where a dedicated inspectorate, headed by a veterinarian, can ensure that high standards of animal welfare and food safety are maintained. Lack of appropriate food safety assurance systems are problems that have become obstacles to economic development and public health safety. The public health threats rising from animal products are currently international issues as a result of global trades. Therefore, veterinarians have a different role in the production of safe food animal origin beginning from the farm to fork in hygienic manner. This seminar is aimed to assess the roles of veterinary service in production of safe food animal origin. Thus, both the professionals and government should have to co-operate in order to improve animal and public health.

Keywords

Animal health, Animal origin, Animal products, Public health, Veterinarians, Veterinary service, zoonosis.

List of Abbreviations

BSE: Bovine Spongiform Encephalopathy, DDT: Dichlorodiphenyltrichloroethane, FAO: Food and Agriculture Organization, NGO: Non-Government Organizations, POPs: Persistent Organochlorine Pesticides, RMF: Risk Management Framework, SRM: Specified Risk Materials, TB: Tuberculosis, WHO: World Health Organization, WTO: World Trade Organization.

Introduction

Foods of animal origin can serve as potential threats to human health if not properly handled. Contaminations of foods such as biological, chemical and physical with pathogenic microbes and chemical residues. These contaminations may result from production at the farm level, transportation, storage, distribution

and preparation for consumption, diseased animals and unhygienic handling of animal products such as milk and meat. It is estimated that hundreds of several people are affected by food-borne diseases of animal origin annually particularly in developing countries [1]. Contaminated foods of animal origin in producing countries may cause food-borne disease outbreaks in importing countries. Thus, globalization of trade has created food safety international issue [2].

In a modern food safety surrounding, veterinarians play an essential role in the prevention and control of food borne zoonotic diseases and/or infections. which are likely to be naturally transmitted from animals to human and other sources of foodborne disease (example; food vehicles, meat and meat foodstuffs, milk and milk foodstuffs, eggs and egg foodstuffs, fish and fish foodstuffs [3]. The risk of food-borne diseases greatly reduced with the present methods to food safety that targets prevention of contamination from the farm level through processing, stored distribution of foods of animal origin [4].

Veterinarians are trained to perform health care services in multi-animal species. This creates a moral linkage to human health workers in comparative and human medicine, agriculturalists in livestock farming, environmentalists in wildlife medicine and many other professions wherever animals are involved, especially food safety, public health and zoonosis control [5]. Veterinary service is considered as a national and global public good and thus it becomes the duty of national governments and international communities. While at international level, Office of International Epizootics (OIE) and Food and Agriculture Organization (FAO) of the United Nations are performing major functions of global veterinary service reasonably well, in fact responsibilities of the respective national governments to establish and administer an efficient veterinary service in their corresponding countries [6]. Veterinary Services play a crucial role in the prevention and management of contagious animal diseases, zoonosis and foodborne zoonotic hazards, even when animals do not present clinical signs. In many countries, in parallel with their primary position on the farm, Veterinary Services (in the form of private veterinarians) have diversified their professional activities by taking up positions at various links in the production chain [7].

The historical separation of veterinary and medical services in different departments between which there is no effective collaboration was due to lack of understanding the veterinarian's potential contribution to community health care in developing countries [8]. Most people were asked to consider what word they would associate with veterinarians. It was likely they associated it with cattle, equines, dogs, cats, and their health. Vets are not only trained to deal with all non-human animals, but also they trained in a particularly wide set of disciplines, protecting public health is one of the areas that vets involve. As a country begins to bring serious disease under control the scope of official animal health service was normally increased to address public health problems originating from livestock and their products. The role of veterinary service was extended from farm to food processing plants, where veterinarians have dual duties (surveillance of animal disease and implementation of safety of food of animal origin [4].

Veterinarians can use their veterinary skills, knowledge and personal effects to protect and increase human health and welfare. It consists of a wide variety of professional areas linking the three elements of the health triangle: humans, animals and the environment, with all their interactions. The discipline of veterinary service has evolved through three stages, i) beginning with the fight against animal diseases, ii) then moving on to include meat inspection and control of zoonosis and iii) now encompassing much broader health sciences education, with the goal of certifying a safe and wholesome food supply, protecting human wellbeing and saving the environment [9].

Therefore, the objective of this review is:

- To give highlights on the role of veterinarian in food safety of animal origin.

Roles of Veterinary Service

Definition

Veterinary Services means the Governmental or Non-governmental organizations that instrument animal health, animal welfare and other standards that prevent the animal from any damage and protect the consumers from zoonosis disease in a country. Veterinarian means a person registered or qualified by the relevant veterinary legal body to practice veterinary medicine/science in that country [10]. Veterinary services can be classified in four categories: protective services (avoiding the outbreak of diseases), production and productive service (such as artificial insemination), Human health protection service (inspection of marketed animal products) and Clinical services (treatment of diseased animals and control of production limiting disorders) [11].

According to World Bank, animal health services include curative and the provision of pharmaceuticals under preventive service. Curative services include the provision of clinical care, while protective services consist of vaccination, vector control, and disease control measures such as quarantines and movement restrictions.

Roles in Control of Livestock Diseases at the Farm Level

In recent years, issues of food safety focus on the fabrication of safe food unlike the traditional methods of checking for the safety of foods that are already marketed for human consumption [12]. Veterinarians should ensure that animals are handled in hygienic manners on the farm. Animals on farm should be routinely examined for endemic food-borne zoonosis to ensure that products from diseased animals are not promoted for human consumption. They should also confirm that to produce an abundant safe supply of high quality milk, dairy cows must be healthy. Through their presence on farms and proper collaboration with farmers, the Veterinary Services play a key role in ensuring that animals are kept under hygienic circumstances and in the primary detection, surveillance and treatment of animal diseases, including conditions of public health significance [13].

The Veterinary Services may also provide livestock producers with information, advice and training on how to avoid, eliminate or control food safety risks (e.g. drug and pesticide residues, mycotoxins and environmental contaminants) in primary production, including through animal feed. For example, if the animal feed is inappropriate or toxic it will affect the health of animals and in some cases, the toxin in the animal feed can be engaged by the animal and then passed on to the consumer in the milk, meat or eggs produced [14]. The source of food animal is the most important criteria and prerequisite for any food processing plant. In modern food producing companies, food animals are usually obtained from well-organized farms where contagious diseases are unlikely to occur. Through their presence in farms and appropriate collaboration with farmers and other professionals, vets play a key role in ensuring the production of healthy animals which is acceptable for food [15].

Animal welfare

The vet's responsibility to ensure that the product of the animal origin is uncontaminated by herbicides, pesticides, and veterinary medicinal products, and to ensure that risks associated with animal health and zoonotic disease are controlled, can only be effectively achieved through a specifically designed animal health plan [16].

Medicine use

On every livestock farm there will be a farmer annoying to raise animals or birds. Vets who visit the farms will be controlling the farmer in his use of medicines for any animals that get sick. They will want to make sure that he uses the right treatment for the right species and the correct dose. Furthermore, they will be advising the farmer to ensure that he has records of what drugs he uses on the farm and which individual animals receive these drugs. One of the most important reasons for this is to ensure that any animal, which is conducted to slaughter, has drug residues below the permitted limit before it is slaughtered. This period is known as the "withdrawal period (Withdrawal periods are typically around two to three weeks. However, for some drugs the withdrawal period can be as short as 12 hours and for others as long as many months and Vets will also want to assist and advise the farmer in the use of antibiotics because of the risk of drug resistance to antibiotics [17]. Bacteria that are resistant to antibiotics represent a risk to future generations of animals, which may get sick. If the bacteria are very resistant to antibiotics, there may be no medicines available to the farmer for him to treat a sick animal. It is also possible, in certain conditions that these resistant bacteria could reach a slaughterhouse or a market, affecting meat or milk to become polluted, which in turn may cause antibiotic resistance to be transferred to the consumers of such products [18].

Animal and Zoonotic Disease

Vets are educated to diagnose disease. Diseases of great interest to them are zoonosis, which are diseases that can affect both animals and man if a vet suspects zoonosis, such as tuberculosis (TB), is on a farm, he will want to take certain steps. The first two steps will be to confirm the diagnosis and control the disease outbreak. The third will be to make sure that the disease does not pass in the food chain, in this case, through the milk or through the meat [18].

Animal feed

The global food system is experiencing profound changes in consumption patterns, especially in the growing demand for livestock products, primary to worldwide growth in intensive livestock production. In turn, there is an increasing need for adequate feed materials, which need to be wholesome and nontoxic for the animal as well as free of undesirable or toxic substances that could compromise the quality and safety of animal-derived foods Vets will also have interest in the food the animals consume. This is because, if the animal feed is poisoned or toxic, it will affect the health of the animals, and in some cases, the toxin in the animal feed can be absorbed by the animal and then distributed on to the consumer in the milk, meat or eggs produced [19].

Sources of Contamination in Animal Feed

Biological Hazards in Feed

The maximum common biological hazards are zoonotic bacterial pathogens that enter the food chain via contaminated feeds and poor hygienic conditions at the farm level. The animal may experience clinical disease conditions, but in many cases remain a silent carrier of such pathogens (such as *Campylobacter*). When hygienic barriers are incomplete during slaughter and processing, the pathogen is transferred to meat, where they can multiply under certain conditions [17]. Eggs can be infected by horizontal transmission of pathogens in layer units and milk may be contaminated by mastitis pathogens prior or during the milking process. Typical examples for such zoonotic pathogens are *Campylobacter* spp. in poultry, *Salmonella* spp., *E. coli* O157, *Enterococci*, and *Staphylococcus* spp [17]. Poor hygienic conditions at the farm level and raw materials used in feed manufacturing can be a source for the introduction of salmonella into the food chain. Feedstuffs and poultry feeds are contaminated by *Enterococci* and, to a lesser extent, by *E. coli*, thus leading to their introduction in the farm environment. Silage is the most common source of *Listeria monocytogenes* on a farm [20]. In addition to bacteria, animal feeds can be contaminated with prions, the infectious agent associated with Bovine Spongiform Encephalopathy (BSE). The prevalence of these prions is currently declining world-wide. Other microbiological exposures and a detailed global survey on food borne diseases are presented in a recent WHO publication [21].

Pesticides

Different kinds of pesticides are commonly used in agriculture for various purposes. Among those, organophosphates, pyrethroids and carbamates are comparatively rapidly degraded and consequently found in lesser amounts in feed and food, while persistent organ chlorine pesticides (POPs) and even banned pesticides such as dichlorodiphenyltrichloroethane (DDT), may still be present as unwanted chemical residues in animal feed due to their low biodegradability and Due to their lipophilic properties, pesticides are stored in fat-rich tissues, forming undesirable residues in meat and may be subsequently Trans located and excreted through milk or fat. Organophosphate pesticides are less lipophilic, and less persistent in animal tissues, but may cause clinical intoxications in animals. At the global level, the environmental burden of most pesticides is reducing with the exception of dioxins, which remain of concern as important contaminants in the food chain [21].

Natural toxins

Among the natural toxins, mycotoxins have an important impact on human and animal health, resulting also in financial and global trade implications most mycotoxins are rather stable and resist common feed processing procedures. The most prominent example is aflatoxin B1, which is considered as one of the strongest liver carcinogens in humans as well as in all animal species tested. It occurs in a broad variety of food and feed materials. Aflatoxin B1 does not accumulate in animal tissues, but gets converted in the liver to aflatoxin M1, which is excreted in milk [17]. Worldwide the regulatory authorities are aiming to protect human and particularly infants from exposure to aflatoxin B1 and M1. Animal-

derived products, such as poultry meat and porcine kidneys and tissues are regularly found to contain residual amounts of ochratoxin A, which might be implicated in the prevalence of renal diseases and even cancer in humans. Another potentially carcinogenic mycotoxin is fumonisin B1, the most toxic derivative of the class of fumonisins, produced by *Fusarium* species. Direct exposure to humans particularly in regions with a traditional high consumption of yellow corn (maize) remains of concern, while exposure via animal-derived products is negligible. At the global level the increases of *Fusarium* toxins in food and feed materials is of increasing concern, and cause significant losses in animal production and impair animal health and productivity [22].

Roles of Veterinarians Service in Food Processing

Veterinary participation in food processing is seen mainly in the inspection of food factories, meat, milk, cheese and yoghurt. One example of this was the importing country's requirement for veterinary inspection to confirm that meat was deboned and cooked to avoid Foot and Mouth Disease virus from surviving the manufacturing process and being imported (the virus survives for a long time in bone marrow. Another example was the requirement for veterinary inspection to confirm moon cakes were cooked to a certain temperature and specified time in order to reduce the risk of Newcastle disease virus, Salmonella, and other serious pathogens passing through the manufacturing process [23].

Role of Veterinarians Service at the Abattoir

Ante-mortem inspection categorizes animals not fit for human consumption. Here animals that are down, disabled, diseased, or dead are removed from the food chain and labeled "condemned." Other animals showing signs of being sick are labeled "suspect" and are segregated from healthy animals for more thorough inspection during processing procedures. Post-mortem inspection of the head, viscera, and carcasses helps to identify whole carcasses, individual parts, or organs that are not healthy or unsafe for human consumption [24].

Animals or birds are often transported directly from the farm to slaughterhouse. In this process, veterinarians have many different roles. Initially they are involved in checking the health and welfare of the animals at some of the stages of transport to the slaughter house and once there, in the ante-mortem inspection prior to slaughter. In most developed countries ante- and post-mortem meat inspection at the slaughterhouse is carried out (or audited) by them as they are regarded as the most, if not only, competent and qualified persons to do such inspections. A general high level of hygiene in a slaughter house is vital. For example, important to make sure that there is no contamination (particularly of bacterial origin) and between 'unclean' parts of a carcass such as stomach contents and the meat, which people will actually eat. In Bovine Spongiform Encephalopathy (BSE) endemic countries there are additional hygiene requirements, i.e. the separation of Specified Risk Materials (SRM) from the rest of the carcass in the prevention of the spread of BSE [25]. Slaughter house inspection of live animals (ante-mortem) and their carcasses (post-mortem) plays a key role in both the surveillance network for animal diseases

and zoonosis and confirming the safety and suitability of meat and by-products for their intended uses. Control and/or decrease of biological hazards of animal and public health Importance by ante- and post-mortem meat inspection is a core responsibility of the Veterinary Services and they should have primary responsibility for the development of important inspection programs [26].

Role in Providing Residue-Free Animal Product

Veterinarians are not primarily concerned with the increase in production by treating the sick animals and poultry but their important job is to confirm quality (residue free) edible animal products such as milk, meat and eggs to the public. The applications of WTO regulations demand that veterinarians working in food animal medicine should learn how to avoid drug/chemical residues in food animals and distribute this information to the farmers to safeguard the health of general public. This issue is also of paramount importance for the veterinarians employed in pharmaceutical and regulatory sectors responsible for assessing the fate of drugs and chemicals that enter the human food chain via the edible products. It is also need of the day that environmentalists, toxicologists and non-government organizations (NGO) should pay due attention towards this issue. This is necessary to conduct complete risk assessment, risk management, risk communication studies and implement certain legislative measures to safeguard the public health [27].

Hazards of drug residues

Potentially, there are two types of hazards relating to drug residues i) direct and short term hazards, and ii) indirect and long term hazards [27].

Direct and Short Term Hazards

Drugs used in food animals can disturb the public health because of their secretion in edible animal tissues in trace amounts usually called residues. For example, oxy tetracycline [28] and enrofloxacin residues [29] have been found above the maximum residual level in chicken tissues. Some drugs have the potential to produce toxic reactions in consumers directly and other types of drugs are able to produce allergic or hypersensitivity reactions. For example, 2-βactam antibiotics can cause cutaneous eruptions, Dermatitis, gastro-intestinal symptoms and anaphylaxis at very low doses. Such drugs include the penicillin and cephalosporin groups of antibiotics then the vet's role is giving some advices to animal owners to avoid use of products from the sick animal or treated by the drug [30].

Indirect and Long Term Hazards

Indirect and long-term hazards include microbiological effects, carcinogenicity, reproductive effects and teratogenicity. Microbiological effects are one of the most important health hazards in human beings. Antibiotic residues consumed along with edible tissues like milk, meat and eggs can produce resistance in bacterial populations in the consumers. This is one of the most important reasons of therapeutic failures amongst such peoples. Certain drugs like 3-nitrofurans and nitroimidazoles can cause cancer in human population. Similarly, some drugs can produce

reproductive and teratogenic effects at very low doses consumed for a prolonged period of time [31].

Chemical Residues

Not only the drugs, but also chemical residues are also harmful to the public health. Pesticides are commonly used in agriculture. It has been estimated that about three million cases of pesticide poisoning occur worldwide each year, with 220,000 deaths. Majority of these poisonings occur in developing countries due to less safety against exposure, ignorance from health risk and easy access to harmful chemicals. Pesticides have contributed to dramatic increase in crop yields and in the quantity and variety of the diet. Also, they have helped to limit the spread of certain diseases. But pesticides also have harmful effects; they can cause injury to human health as well as to the environment. The range of these adverse health effects includes: acute and persistent injury to the nervous system, lung damage, injury to the reproductive organs, and dysfunctioning of the immune and endocrine systems, birth defects, and cancer. Problems associated with pesticide hazards to man and the environment are not confined to the developing countries the vets role is creation of awareness in the effect, prevention, and control of using chemicals by the farmers which is used the chemicals illegally or in wrong places such as ponds and lakes [32].

Roles in the Storage and Transport of Food

Traditionally, food inspectors are involved in the inspection of the wholesale side of the food process. However, vets do have a great interest in how food of animal origin is stored prior to going to merchants [33] this is an area where if one is not careful, mistakes can occur. In this respect, it is important that batches of food are kept separate from each other and are clearly marked and identified with their movements recorded [34].

Veterinary involvement in food processing is seen mainly in the inspection of food factories, meat, milk, cheese and yoghurt one example was the requirement for veterinary inspection to ensure moon cakes were cooked to a certain temperature and specified time in order to reduce the risk of Newcastle disease virus, Salmonella, and other serious pathogens passing through the manufacturing process. In addition, Veterinarians have also inspected food-processing facilities in which export livestock and food of animal origin [23].

Roles in Certification of Animal Products for International Trade

Another important role of the Veterinarian is to provide health certification to international trading partners at testing that exported products meet both animal health and food safety standards. Certification in relation to animal diseases, including zoonosis, and meat hygiene should be the responsibility of the veterinarians and the department of veterinary services. In addition, veterinarians should also ensure that importers of live animals, animal products. Veterinary biological present certificates of health before such animals and products are allowed into the country, as it is required by law [23]. The controlling structure to

control food safety and health issues can generally be divided into three main elements of requirements, conformity assessment and enforcement export certificates refer to both product and process standards, including management and monitoring systems along the entire food supply chain that are increasingly fulfilled and aim at reducing the probability that the production and consumption of products results in hazard for humans, animal and plant health. The requirements stated in export certificates can be those of the importing country, the exporting country or a mixture of both. Most importantly, export certificates stipulate that the exporting country must be free of certain infectious animal diseases, such as, Anthrax, Bovine Tuberculosis, brucellosis or BSE in order to maintain the disease-free status in the importing country, or to accommodate other animal health and food safety objectives [35].

Certification in relation to animal diseases, including zoonosis, and meat hygiene should be the accountability of the consumer, Veterinary Authority Certification may also provide by other professions (a sanitary certificate) in construction with food processing and sanitation (for example, pasteurization of dairy products) and conformance with product superiority standards [6]. Certificate is regarded, within the veterinary profession, as an exceptionally important document, which as far as it is humanly possible replicates the whole truth. Veterinary certificates, since they have to be completed to the highest possible standards, are very useful in facilitating international trade. The importer expects that what is written on the veterinary health certificate is true and believable. It is on these ethical principles that the OIE uses veterinary health certificates to ensure that food is nontoxic to eat can cross borders [18].

Roles of Veterinarians in Risk Based Management System

A generic risk management framework (RMF) provides a systematic process whereby food safety standards and other measures are chosen and implemented on the basis of knowledge of risk and evaluation of other factors relevant to protecting human health and the promotion of nondiscriminatory and least trade-restrictive practices [12]. Veterinary Services have vital roles in the application of the RMF process. Whereas others require multidisciplinary inputs. Once a food safety issue has been identified, the initial process is the establishment of a risk profile to place the issue within a particular context and provide as much information as possible to guide further action. Risk profiling may also be used for ranking or prioritizing different food safety issues [36]. The development of risk-based systems has been seriously influenced by the WTO agreement on the application of sanitary and phytosanitary measures ("SPS Agreement"). This agreement stipulates that signatories shall ensure that their sanitary and phytosanitary measures are based on an assessment of the risks to human, animal or plant life or health, taking into account risk assessment techniques developed by relevant international organizations. Risk assessment, the scientific component of risk analysis, should be functionally separated from risk management to avoid interference from economic, political or other interests [37]. According to the World Trade Organization (WTO) trade rules, import requirements are not to exceed domestic supplies.

However, importing countries can enforce further reaching and different food safety and health standards under the sanitary and phytosanitary agreement, and include them in the respective export of complex trade issues, the Official Veterinarian is in a unique and quite special position to facilitate trade between international partners [38]. The Veterinary Services play a crucial role in the application of the risk analysis process and the implementation of risk-based recommendations for controlling systems, including the extent and nature of veterinary involvement in food safety activities throughout the food chain, as outlined above [12].

Roles in Food Safety through Trace Back

If a food poisoning problem does occur in the marketing or domestic cooking area, vets will want to be informed by their public health colleagues about the identity of the suspected food. This is because worldwide opinion is important to check the whole food producing system, as the problem may not be just in the restaurant or at home. In particular, they will want to know the batch number, name of the food manufacturer, name of the food and other details to help with identification and trace back. They will then start the “trace back” exercise processes and systems were originally developed in the USA and Europe [18]. The aim of the trace back exercise is to find out where in the chain the problem has occurred. Did the problem occur at the point of sale for example a restaurant? If not then did the problem occur at a food storage point? If so, which one and what other foods were stored at that time and place? Alternatively, did the problem occur at a processing and if so, which one? This is highly relevant for example with ground beef and *E.coli* O157 food poisoning. If not these ones did the problem occur at a food factory? Which one and on what day? What other batches of food from that factory may be affected? If not the food factory, what about the Abattoir? If not the abattoir, the livestock transport lorries to the abattoir or finally the farm itself or the feed going into the farm. In this whole trace back process, many professions will be involved not only vets, but also researchers of animal feeds will have a great role if the source looks likely increase to be from the farm itself, there is a much greater veterinary involvement as compared to other professions [13].

Conclusion and Recommendations

Generally, Veterinary Service has a key role in protection and providing of safe food, which is recognized as a public good. Additionally, they are chiefly important in the providing of such a public good associated with the protection of public health, animal health and animal welfare. The responsibilities for ensuring the safety of whole food chain, Veterinary Services must declare their position as leader or principal coordinator. Veterinarians have the activities at every link in the food chain from production to consumption, and have the knowledge and expertise to assessment the standards of animal health, animal welfare, zoonosis control, public health, and contribution of animal waste to pollution of other foodstuffs.

Based on the above conclusion the following recommendations are forwarded:

- Animal product industry owners, government and non-governmental organizations should give high attention to

animal health and food safety of animal origin.

- Vets should have update themselves with the knowledge related to the sources of food contamination that leads negative impact on the consumers health.
- Vets should take any awareness creation measures to the people about the causes, impact and prevention of the food borne disease from animal origin foods.
- Government should be creating good conditions for the vets to motivate themselves and to be accountable for the consumers.
- Vets should strive to equip themselves to have the required knowledge and skill almost comparable with the international animal and food safety experts.

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