Master of Public Health

Integrative Learning Experience Report

FOOD SAFETY REGULATIONS: A VIRTUAL JOURNEY ACROSS THE GLOBE

by

Phutsadee Sanwisate

MPH Candidate

submitted in partial fulfillment of the requirements for the degree

MASTER OF PUBLIC HEALTH

Graduate Committee:
Justin Kastner
Abbey Nutsch
Valentina Trinetta

Public Health Agency Site:
European Union; Department of Livestock Development, Thailand; Kansas Department of Agriculture; Food Science Institute, KSU
Summer and Fall 2020

Site Preceptor:
Justin Kastner, PhD

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2021

Summary/Abstract

This report summarizes the *online* field experiences gained from various mentors during the Summer and Fall of 2020. The author corresponded with a mentor from the European Union (EU) to learn about EU food safety regulations, which are essential in the Thailand-EU agri-food trade, especially in the poultry meat sector. Thai producers must comply with the EU regulations to export products to the EU. The author also corresponded with a mentor from the Kansas Department of Agriculture to learn about Kansas's food safety regulations related to meat and poultry products. Meat producers in Kansas must follow the Kansas Meat and Poultry Inspection Act. Meat inspectors play an essential role in the safety of meat products in Kansas. The food microbiology laboratory plays a necessary role in regulators' and food companies' identification of foodborne pathogens. The author learned about specific laboratory tests used in food safety regulation from a mentor in KSU's Food Science Institute, as well as from several KDA laboratory officers. The author also learned about the practical application of international food safety standards established by the Codex Alimentarius Commission (Codex) and the World Organization of Animal Health (OIE) related to the poultry sector. Such international standards facilitate trade and enhance the safety of food in global trade. The author's preceptor, Dr. Justin Kastner, encouraged the author to explore in additional detail selected topics related to food safety and international trade; these included career-development insights from her mentors, peculiar or interesting regulatory issues related to raw milk and seafood, and other interesting topics. The author is grateful for her mentors and her preceptor because the author was able to gain practical, public health knowledge during the midst of the Covid-19 pandemic via this innovative *online* field experience. The author now understands more about EU food safety regulations, Kansas's regulations, laboratory tests, and international food safety standards.

Subject Keywords: Online field experience, KDA, EU food safety regulations, Kansas food safety regulations, Thailand's poultry sector, food microbiology, SPS Agreement, Codex, OIE

Table of Contents

Summary/Abstract ii
List of Abbreviations 2
List of Figures 5
List of Tables 6
Chapter 1 - Literature Review: Food Safety and Biosecurity, Trade Policy, and SPS Regulation in the European Union, Thailand, and the State of Kansas 7
Chapter 2 - Learning Objectives and Project Description 21
Chapter 3 - Reflection, Analysis, and Key Observations 23
3.1 Career development learning from mentors 23
3.2 General requirements required before KDA inspects facilities 26
3.3 The interesting case of *Staphylococcus aureus* and its absence in KDA inspection protocols 27
3.4 The unique challenge and opportunity of Thailand's compliance with EU regulatory requirements 28
3.5 Compartmentalization in Thailand: A story of complex implementation 30
3.6 The EU's microbiological criteria for raw milk 34
3.7 A selected EU regulation of interest 36
Chapter 4 - Competencies 39
Student Attainment of MPH Foundational Competencies 39
Student Attainment of MPH Emphasis Area Competencies 43
References 46
Appendix 51

List of Abbreviations

ACFS	National Bureau of Agricultural Commodity and Food Standards
APC	Aerobic Plate Count
APE	Applied Practice Experience
BA	Blood Agar
CAC	Codex Alimentarius Commission
CDC	Centers for Disease Control and Prevention
CFIA	Canadian Food Inspection Agency
CFR	U.S. Code of Federal Regulations
CFU	Colony Forming Unit
CSU	Colorado State University
DF	Department of Fishery
DG-SANCO	Directorate-General for Health and Consumers
DG-SANTE	Directorate-General for Health and Food Safety
DLD	Department of Livestock Development
DOA	Department of Agriculture
DVFA	Danish Veterinary and Food Administration
EC	European Commission
EFSA	European Food Safety Authority
ELISA	Enzyme-Linked Immunosorbent Assay
EMB agar	Eosin Methylene Blue agar
EU	European Union
FDA	United States Food and Drug Administration
FSIS	Food Safety and Inspection Service
GAO	The U.S. Government Accountability Office
GMP	Good Manufacturing Practice
HACCP	Hazard Analysis and Critical Control Point
HHS	The U.S. Department of Health and Human Services
HPAI	High Pathogenic Avian Influenza
ILE	Integrative Learning Experience

iMOVES	International Mobility of Veterinary Students
IPPC	International Plant Protection Convention
KDA	Kansas Department of Agriculture
KMPIA	Kansas Meat and Poultry Inspection Act
K.S.A.	Kansas Statutes Annotated
KSU	Kansas State University
MLG	Microbiology Laboratory Guidebook
MOAC	Ministry of Agriculture and Cooperative
MOPH	Ministry of Public Health
MOX agar	Modified Oxford Agar
MPH	Master of Public Health
NAI	Notifiable Avian Influenza
NB	Nutrient Broth
NEP	National Enquiry Point
NNA	National Notification Authority
OIE	World Organization for Animal Health
PCR	Polymerase Chain Reaction (PCR)
PFGE	Pulsed-field gel electrophoresis
PPE	Personal Protective Equipment
PSU	Pennsylvania State University
SOP	Standard Operating Procedure
SPC	Standard Plate Count
SPS	Sanitary and Phytosanitary
STCs	Specific Trade Concerns
STEC	Shiga toxin-producing Escherichia coli
TAMU	Texas A&M University
TAS	Thailand Agricultural Standard
TSA	Tryptic Soy Agar
TSB	Tryptic Soy Broth
TSI	Triple Sugar Iron
UniPD	University of Padova

U.S.	United States
USDA	United States Department of Agriculture
UVM broth	University of Vermont Medium broth
WGS	Whole Genome Sequencing (WGS)
WTO	World Trade Organization

List of Figures

Figure 1.1 The webpage of third country establishments that can export meat, meat products, and animal by-products to EU. 9
Figure 1.2 The Kansas Inspection Legend: This symbol indicates that the operation has complied with the Kansas program's regulatory requirements (KDA, 2016b)..... 10
Figure 1.3 Contribution of Different Food Commodities (Categories) to Estimated Domestically-Acquired Illnesses and Deaths, 1998-2008. 16
Figure 1.4 The food microbiology laboratory at the Food Science Institute, KSU. 17
Figure 1.5 The serial 1:10 dilution..... 18
Figure 3.1 The environs of the KSU Gardens when meeting with Dr. Kastner outdoors in the summer and early fall of 2020. 23
Figure 3.2 Dr. Kastner, several veterinary students, and the author met Dr. Lorenzo Terzi in Bologna, Italy in the summer of 2019. 24
Figure 3.3 Dr. Kanyarat Saensukjaroenphon; she is one of the author's mentors for the online field experience. 26
Figure 3.4 The distribution of HPAI (H5N1) outbreaks in Thailand from 2004 to 2008. 29
Figure 3.5 Disinfection of all vehicles before entering the farm. 32
Figure 3.6 Thorough cleaning and disinfecting of a poultry house after flock harvesting. 33
Figure 3.7 Visitors wearing PPE provided by the farm. 33
Figure 3.8 The loading docks of the seafood processing company "Fiorital," in Venice, Italy ... 36
Figure 3.9 A group of veterinary students including the author pose for a photo with the Fiorital Company's staff in Venice, Italy. 36
Figure 3.10 Dr. Valerio Giaccone's lecture at Fiorital Company, Venice, Italy. 37

List of Tables

Table 1.1 Thailand's exported livestock products from 2016 to 2020 12
Table 1.2 Top five pathogens contributing to domestically acquired foodborne illnesses..... 14
Table 1.3 Pathogens contributing to domestically acquired foodborne illnesses resulting in hospitalization 15
Table 1.4 Top five pathogens contributing to domestically acquired foodborne illnesses resulting in death 15
Table 3.1 The number of certified NAI free compartments in Thailand's poultry sector in 2020 32
Table 4.1 Summary of MPH Foundational Competencies Table 39
Table 4.2 MPH Foundational Competencies and Course Taught In 41
Table 4.3 Summary of MPH Emphasis Area Competencies 43

Chapter 1 - Literature Review: Food Safety and Biosecurity, Trade Policy, and SPS Regulation in the European Union, Thailand, and the State of Kansas

From the United Nations definition, food safety means "the absence—or safe, acceptable levels—of hazards in food that may harm the health of consumers" (United Nations, 2021). For fundamental living, people in every nation should consume safe foods. Therefore, food safety practices are needed at every stage of the food chain from production to harvest, processing, storage, distribution, all the way to preparation and consumption.

Food safety regulations play an essential role in both national and international trade policies. From the summary of the United States Government Accountability Office (GAO), different countries have different approaches to governing their food systems. A national government can establish different organizations in their country to lead food safety management or enforcement of food safety legislation (United States Government Accountability Office, 2005). A brief sampling of examples illustrates a diversity of government approaches. For example, in Canada, the Canadian Food Inspection Agency (CFIA) has responsibility for all inspection/compliance activities, including inspections of imported/domestic products, laboratory and diagnostic support, crisis management and product recalls, and export certification. The agency of Health Canada has responsibility for public health policy and standard-setting, including research, risk assessment. In another context and country, in Denmark, the Danish Veterinary and Food Administration (DVFA) in the Ministry of Family and Consumer Affairs, is responsible for almost all food safety responsibilities. The Danish Directorate for Fisheries is responsible for fish inspections on ships. To make things more complex, Denmark is also a European Union member. Therefore, its food safety policies and standards need to follow and comply with EU regulations. The author of this ILE document has always been interested in the food safety policy frameworks of the EU; with the guidance of her advisor, she was able to pursue this interest.

The European Union (EU) consists of 27 country members. The Directorate-General for Health and Food Safety (DG-SANTE), formerly known as the Directorate-General for Health and Consumers (DG-SANCO) until 2014, is a Directorate-General of the European Commission (EC). DG-SANTE has responsibilities for implementing European Union laws on food safety and other

product safety, and on the protection of people's health (European Commission, 2021). The European Food Safety Authority (EFSA) is the EC consultant to provide independent scientific advice to the decision makers in the EU.

The author had an excellent opportunity to join the International Mobility of Veterinary Students (iMOVES) program in the summer of 2019. She visited a cattle slaughterhouse, a seafood processing plant, and a chicken farm in Italy. She recognized that they strictly follow the EU food safety regulations, especially "the Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety." This regulation is important for food safety and hygiene according to a lecture by Dr. Valerio Giaccone, Department of Animal Medicine, Production and Health, University of Padova.

The EU has many trading partners from various countries around the world, and the author of this ILE (a government veterinary officer from Thailand) can testify to this. The EU's annual production of poultry products is about 12.6 million tons. The EU is one of the world's largest poultry meat producers and exporters. However, the EU still imports poultry products such as breast meat and poultry preparations, mainly from Brazil, Thailand, and Ukraine (European Commission, 2019). Trading partners know if they can export meat, meat products, and animal by-products by checking on the EU website.[1]

The EU webpage contains categories of products and activities of establishments. Each category is divided into sections as shown in Figure 1.1. Each section contains names of countries and PDF documents that provide the list of establishments' name, address, approval number, and activity.

[1] https://webgate.ec.europa.eu/sanco/traces/output/non_eu_listsPerActivity_en.htm#

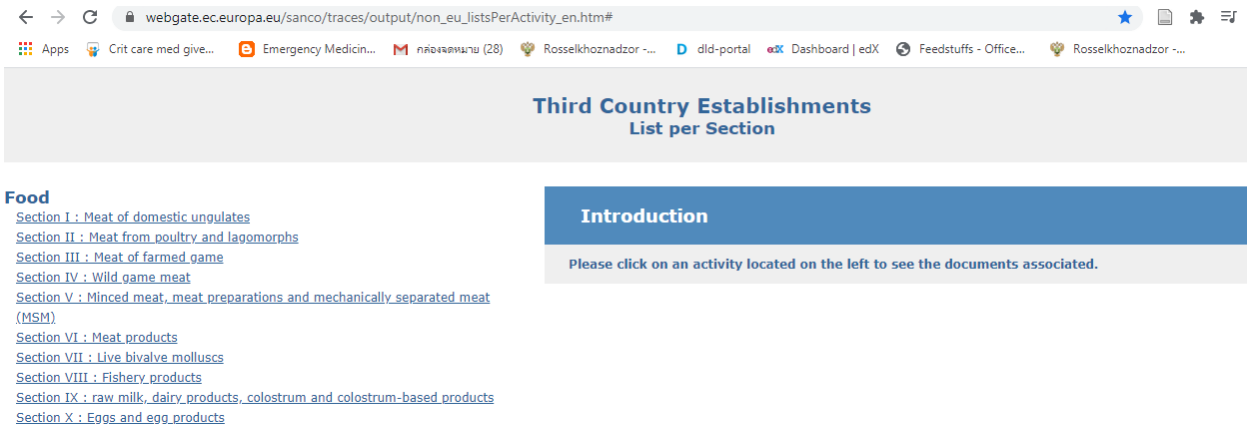

Figure 1.1 The webpage of third country establishments that can export meat, meat products, and animal by-products to EU. Source: European Commission. (2021). *Establishments List per Section*. European Commission - European Commission. https://webgate.ec.europa.eu/sanco/traces/output/non_eu_listsPerActivity_en.htm

The author of this ILE also came to study food safety policy in the United States. The U.S. Department of Agriculture (USDA) and the Food and Drug Administration (FDA) in the Department of Health and Human Services (HHS) are the main governing agencies for food safety in the U.S. USDA's Food Safety and Inspection Service (FSIS) inspects the safety of meat, poultry, and certain egg products. The FDA regulates the safety of all other foods such as milk, seafood, and fruits and vegetables.

In the U.S., both federal policy and individual states' policies play an important role in food safety. The author of this ILE was interested to learn more about food safety policy in the state of Kansas. In Kansas, the Kansas Department of Agriculture (KDA) has responsibility to control Kansas's food safety. One of the KDA's mission is "helping to ensure a safe food supply, protecting natural resources, promoting public health and safety, protecting animal health, and providing consumer protection to the best of our ability" (KDA, 2016b).

Agriculture is a crucial part of Kansas's food economy, and this includes especially meat and poultry products. In 2019, according to the USDA's National Agricultural Statistics Service, there were 6.35 million head of cattle and calves in Kansas. In 2020, there were 2.04 million head of hogs and pigs in Kansas (KDA, 2021).

The Kansas Meat and Poultry Inspection Act (KMPIA) governs meat and poultry products for wholesomeness, appropriate labeling, and truth in advertising. The Kansas Meat and Poultry Inspection Program is responsible for inspection and registering commercial and custom slaughter facilities and meat and poultry processing facilities established in Kansas. Ante- and post-mortem inspection are essential activities following the Kansas Statutes in K.S.A. 65-6a20 ("inspectors are to examine and inspect livestock, domestic rabbits and poultry prior to slaughter"), and K.S.A. 65-6a21 ("inspectors will examine and inspect carcasses and parts thereof of all livestock, domestic rabbits and poultry which are capable of use as human food"). A Kansas Department of Agriculture inspection stamp is used only for safe carcasses and meat products fit for human consumption. The regulation of ante- and post-mortem inspection also can be found in a federal regulation: 9 CFR part 309-310. The key agency for this regulation is the USDA-FSIS, which annually verifies that the Kansas Meat and Poultry Inspection program is "equal to" federally inspected operations. However, state-inspected products can be sold only intrastate. In 2020, there were 28 meat and poultry slaughterhouses and processing plants under KDA inspection, while there were 74 plants under USDA inspection in the state of Kansas (KDA, 2016a).

Figure 1.2 The Kansas Inspection Legend: This symbol indicates that the operation has complied with the Kansas program's regulatory requirements (KDA, 2016b). Source: KDA. (2016). *Meat and Poultry Inspection*. Kansas Department of Agriculture. https://agriculture.ks.gov/divisions-programs/meat-and-poultry-inspection

In Thailand (officially named the Kingdom of Thailand), the central government organizations for food safety regulations and standards are the Ministry of Agriculture and Cooperatives (MOAC) and the Ministry of Public Health (MOPH). MOAC includes the National

Bureau of Agricultural Commodity and Food Standards (ACFS), Department of Agriculture (DOA), Department of Livestock Development (DLD), Department of Fishery (DF), and Rice Department. ACFS is responsible for the establishment of agriculture and food standards following the national and international standards. Moreover, ACFS is Thailand's National Enquiry Point (NEP) for the purposes of complying with the World Trade Organization *Agreement on the Application of Sanitary and Phytosanitary Measures* (SPS Agreement). The DLD is the competent authority for laws and regulations related to livestock products' food safety in Thailand (Department of Livestock Development, 2017), and the DLD also controls and implements the regulations and standards to control animal diseases, animal farms, and slaughterhouses. The DF controls the safety of fish and fishery products (ACFS, 2017). The Food and Drug Administration (FDA), which is under the Ministry of Public Health (MOPH), controls food and drug safety sold in Thailand and administers the Food Act B.E. 2522 (1979).[2] Moreover, the FDA in Thailand also has responsibility for consumer protection, food and drug labeling, and advertising.

Thailand consists of 77 provinces and about 69.8 million people. Thailand is a world-leading producer in the agriculture sector, especially in the poultry industry. Thailand has exported poultry meat and products since 1973 and became one of the major exporters of poultry meat products to the global market, primarily to the EU and Japan. In 2015, around 70% of poultry production, about 1.2 million tons, were consumed domestically, and 30% for export (Netherlands Embassy, 2016, p. 1). In 2019, Thailand exported poultry meat products totaling around 963,085 tons, including chicken and duck products both cooked and uncooked. Table 1.1 shows the data of exported livestock products using the export data from the DLD (Saensukjaroenphon, 2021).

In 2015, Thailand had only 1 million cows. Beef products could only be used for domestic consumption. The beef industry in Thailand the potential to be expanded because of increased consumer demand (Bunmee et al., 2018). In 2020, Thailand was able to export 191 tons of cooked beef products to Japan.

There are 9.51 million swine of all ages. Thailand exports live pigs to Lao PDR, Cambodia, Myanmar, and Vietnam. Thailand can export frozen/chilled pork and cooked products to Hong Kong, Japan, Singapore, Malaysia, and others (Tantasuparuk & Kunavongkrit, 2014). Egg production was around 11.7 billion eggs in 2014, with 11.6 billion eggs destined for domestic

[2] B.E. is an abbreviation of Buddhist Era. The Thailand calendar year is counted after the date Buddha passed away.

consumption. In excess of one hundred million eggs were exported (Netherlands Embassy in Bangkok, 2016). The main importers of eggs and egg products from Thailand are Hong Kong and Singapore.

Table 1.1 Thailand's exported livestock products from 2016 to 2020[3]

Type of product	Exported Volume 2016 (tons)	Exported Volume 2017 (tons)	Exported Volume 2018 (ton)	Exported Volume 2019 (tons)	Exported Volume 2020 (tons)
Processed chicken meat	503,045	546,358	567,479	600,771	531,390
Chilled/Frozen chicken meat	240,299	253,175	324,800	353,426	374,382
Processed duck meat	7,344	6,686	4,073	3,685	2,598
Chilled/Frozen duck meat	4,373	5,189	5,225	5,203	5,405
Processed pork	12,178	10,930	10,684	10,022	8,521
Chill/Frozen pork	1,125	1,572	1,900	6,329	24,435
Processed beef	1,470	2,878	2,461	2,604	2,326
Chilled/ Frozen Beef	0	0	0	0	18
Mixed-Processed Meat	5,516	4,413	3,605	3,413	3,507
Shell eggs	10,981	11,869	19,862	16,483	12,918
Total	**786,335**	**843,073**	**940,093**	**1,001,948**	**965,500**

Source: Saensukjaroenphon, Kanyarat. "Personal Communication regarding livestock exportation in Thailand." Bureau of Livestock Standards and Certification: Department of Livestock Development, 6 January 2021.

Thailand's exported livestock products' volume have increased every year (except the pandemic year of 2020), and the trend will continue. Thailand would like to be the "kitchen of the

[3] The calendar year

world." Therefore, the Thailand government is trying to open new markets in new countries for exported livestock products.

On June 2, 2020, the EU Directorate-General for Health and Food Safety (DG SANTE) published the audit results (of Thailand) of evaluating the animal health controls in place in relation to export of poultry meat, eggs and products thereof to the EU. This audit took place in Thailand from January 28 to February 7, 2020. Overall, the EU was satisfied with the audit results. The DLD can control and guarantee that Thailand's exported poultry meat, eggs, and products complied with the EU animal health requirements (European Commission, Directorate-General for Health and Food Safety, 2020). The Thailand government always collaborates with food producers or food business operators to maintain the food safety standards that comply with international standards and trade partners' regulations.

Sometimes, food safety standards can become a trade barrier. The World Trade Organization (WTO), which consists of 164 member countries, provides the global trade rules to ensure that international trade will be smooth, free, and predictable by applying the multilateral trading system. The multilateral trading system include the WTO's agreements, which were negotiated and signed by the members' governments (World Trade Organization, 2014). The WTO established the WTO *Agreement on the Application of Sanitary and Phytosanitary Measures* (SPS Agreement) to minimize adverse effects of sanitary and phytosanitary measures on international trade by providing guidelines and also addressing the application of food safety, human and animal health, and plant protection rules related to global agricultural trade (Congressional Research Service, 2021, p. 30).

The international trade principle of harmonization is mentioned in article 3 of the SPS Agreement; harmonization is a process for minimizing redundant or conflicting standards. Harmonization can help to reduce discrimination and conflict in global trade. Regulations or standards should follow international standards. For example, sanitary and phytosanitary (SPS) measures should be based on existing standards, guidelines, and recommendations from the relevant international organizations (called "the three sisters") that include the Codex Alimentarius Commission (Codex) for food safety standards, the World Organization for Animal Health (OIE), and the International Plant Protection Convention (IPPC) for plant health standards (World Trade Organization, n.d.). The international trade principle of equivalence is mentioned in article 4; this principle can address unique disputes between trade partners. The WTO-SPS framework's

provision for equivalence determination helped to solve a dispute between the U.S. and Australia on the meat inspection system because it enhanced the collaboration of both countries. The Australian government was willing to change and modify its meat inspection procedures, which the U.S. later accepted (Kastner and Pawsey, 2002). The international trade principle of transparency is addressed in Article 7 of the SPS Agreement; this principle promotes cooperation and predictable trade. Article 7 requires the WTO members to publish all SPS measures, notify changes to other members, and establish a National Notification Authority (NNA) and a National Enquiry Point (NEP) to answer questions from other members about SPS measures and related concerns. All databases of notified SPS measures and Specific Trade Concerns (STCs) can be found from the SPS Information Management System website (http://spsims.wto.org) (Jennings et al., 2011). Thailand is also a WTO member that follows the SPS Agreement. The author of this ILE had a chance to explore how Thailand has adopted relevant Codex and OIE standards for its poultry industry. The author created a PowerPoint presentation on the topic of "The relevance of the Codex Alimentarius Commission (Codex) and the World Organization for Animal Health (OIE) for Thailand's poultry export trade," and this is my APE portfolio product no. 3 (see page 37 and the appendix of the author's APE report).

The international agricultural trade can introduce biological threats to importing countries such as animal diseases, and plant diseases caused by bacteria, viruses, fungi, and protozoa. Foodborne illnesses are also a trade-related concern. Many foodborne pathogens cause foodborne illnesses and deaths in the U.S. and worldwide. The Centers for Disease Control and Prevention (CDC) estimated that 1 in 6 Americans (around 48 million people) develop foodborne illness each year. The top five foodborne pathogens that cause foodborne illnesses, hospitalization, and death in the U.S. are shown in Table 1.2, 1.3, and 1.4, respectively. (CDC, 2018b).

Table 1.2 Top five pathogens contributing to domestically acquired foodborne illnesses

Pathogen	**Estimated number of illnesses**	**%**
Norovirus	5,461,731	58
Salmonella, nontyphoidal	1,027,561	11
Clostridium perfringens	965,958	10
Campylobacter spp**.**	845,024	9
Staphylococcus aureus	241,148	3

Subtotal		91

Table 1.3 Pathogens contributing to domestically acquired foodborne illnesses resulting in hospitalization

Pathogen	**Estimated number of hospitalizations**	**%**
Salmonella, nontyphoidal	19,336	35
Norovirus	14,663	26
Campylobacter spp**.**	8,463	15
Toxoplasma gondii	4,428	8
E. coli (STEC) O157	2,138	4
Subtotal		88

Table 1.4 Top five pathogens contributing to domestically acquired foodborne illnesses resulting in death

Pathogen	**Estimated number of deaths**	**%**
Salmonella, nontyphoidal	378	28
Toxoplasma gondii	327	24
Listeria monocytogenes	255	19
Norovirus	149	11
Campylobacter spp.	76	6
Subtotal		88

Source: CDC. (2018, November 19). *Burden of Foodborne Illness: Findings | Estimates of Foodborne Illness | CDC*. Centers for Disease Control and Prevention. https://www.cdc.gov/foodborneburden/2011-foodborne-estimates.html

CDC data, as shown in Figure 1.3, illustrates that produce, meat and poultry products are primary attribution sources of contamination that cause foodborne illness (CDC, 2013). In Kansas, the KDA Laboratory is responsible for identifying pathogens in meat and poultry products sampled by the meat inspector. The KDA Laboratory procedures follow the USDA FSIS Microbiology Laboratory Guidebook (MLG), which the author learned about and described in APE portfolio product no. 2B (see Table 1.3 on page 30 of the APE report).

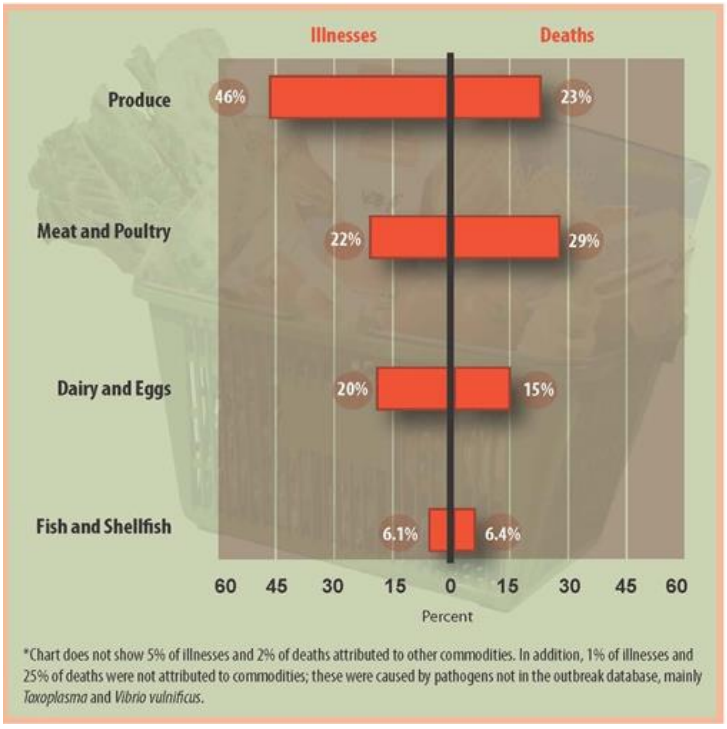

Figure 1.3 Contribution of Different Food Commodities (Categories) to Estimated Domestically-Acquired Illnesses and Deaths, 1998-2008. Source: CDC. (2013, January 29). *Attribution of Foodborne Illness, 1998-2008—Images | Estimates of Foodborne Illness | CDC*. Centers for Disease Control and Prevention. https://www.cdc.gov/foodborneburden/attribution-image.html

The laboratory is essential to identify pathogens in foods. There are many types of laboratory procedures to identify foodborne pathogens; these vary from simple methods to complex methods such as gram staining method, Polymerase Chain Reaction (PCR), Enzyme Linked Immunosorbent Assay (ELISA), and Whole Genome Sequencing (WGS). The author had an excellent opportunity to practice laboratory skills at the Food Science Institute, KSU. Workers in the food microbiology laboratory must follow the laboratory safety information. Aseptic technique should always be applied when practicing in the laboratory to reduce contaminations that affected laboratory results.

Figure 1.4 The food microbiology laboratory at the Food Science Institute, KSU.

The fundamental principles and practicalities within the microbiological discipline that microbiologists should know and follow include the following (not an exhaustive list):

1) **Gram Stain**: It is a common technique used to differentiate between two major groups of bacteria including Gram-positive and Gram-negative bacteria. Gram staining includes four main steps: (1) Staining with crystal violet, (2) Adding iodine solution to form an iodine complex with gram-positive bacteria, (3) Decolorization with alcohol, and (4) Counterstaining with safranin. After staining, we can use a light compound microscope to see the bacteria. Gram-positive bacteria appear in purple because they retain crystal violet color due to a thick layer of peptidoglycan in their cell walls. Gram-negative bacteria appear in red from safranin because they have thinner layers of peptidoglycan, which do not retain the crystal violet during the decoloring process (Trinetta, 2020, p. 8).

2) **Standard Plate Count (SPC) or Aerobic Plate Count (APC)**: Microbiologists use this technique to estimate the number of bacteria. SPC involves many processes: rinsing the samples (if sample is not in liquid form) followed by preparing serial dilutions (using Tryptic Soy Broth (TSB) or Nutrient Broth (NB)), and plating on agar media (e.g., Tryptic Soy Agar or Petrifilm$^{TM)}$) to enumerate bacterial colonies. Colonies on agar media can be calculated using Colony Forming Units (CFU/ ml and CFU/g) (Trinetta, 2020**).**

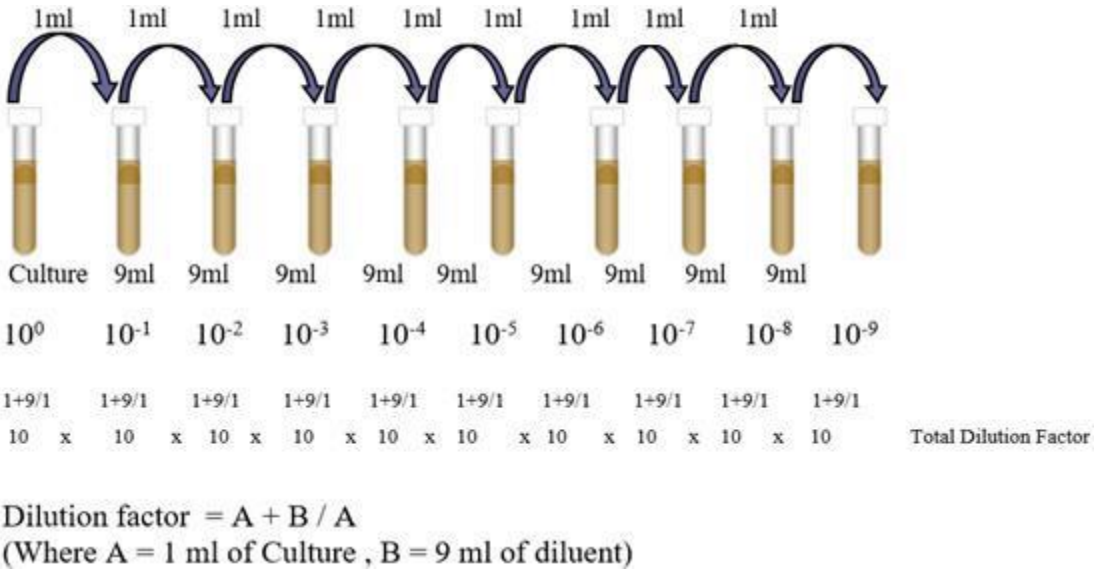

Figure 1.5 The serial 1:10 dilution. Source: Trinetta, V. (2020). *Laboratory Manual in Food Microbiology*. Food Science Institute, Kansas State University.

3) **Biochemical tests**: It is a necessary test used to identify bacteria species based on the differences in the biochemical activities of different bacteria. There are many biochemical tests such as the catalase test, oxidase test, coagulase test, urease test, indole test, API test, and Triple Sugar Iron (TSI) test.
4) **Enrichment culture**: It is a basic isolation technique designed to make growth conditions for only an organism of interest by introducing proper nutrients or environmental conditions. Culture media may be categorized into the following categories (Boundless, 2021):

   Nutrient media – A source of amino acids and nitrogen (e.g., beef, yeast extract). It includes non-selective media on which most types of bacteria can grow such as nutrient agar, plate count agar, and tryptic soy agar (TSA).

   Minimal media – Media that contains the minimum nutrients possible for colony growth (without the presence of amino acids). Microbiologists use it to grow "wild type" microorganisms (e.g., wild type of *Escherichia coli).*

   Selective media – Used for the growth of only selected microorganisms. Antibiotics can be added to the medium to prevent other cells such as MacConkey agar for Gram-negative bacteria, Eosin methylene blue (EMB) contains dyes that are toxic for Gram-

positive bacteria, MOX agar and UVM are a selective medium for *Listeria monocytogenes.*

Differential media – Also known as indicator media, these are used to detect and identify microorganisms by using specific nutrients or indicators (such as neutral red, phenol red, eosin y, or methylene blue) added to the medium. For example, Blood agar (BA) contains 5% sheep red blood cells. BA can check the degree of hemolysis from hemolysins enzymes produced from members of the genera *Staphylococcus* and *Streptococcus*.

5) **Enzyme Linked Immunosorbent Assay (ELISA)**: The ELISA technique can be used for detecting pathogens in food samples. It is an antibody-based test method and an effective method for detecting and quantifying a specific protein in a complex mixture. ELISA normally involves four basic elements: "(1) C**oating/capture**–direct or indirect immobilization of antigens to the surface of polystyrene microplate wells, (2) **Plate blocking**–addition of irrelevant protein or other molecules to cover all unsaturated surface-binding sites of the microplate wells, (3) **Probing/detection**–incubation with antigen-specific antibodies that affinity-bind to the antigens, and (4) **Signal measurement**–detection of the signal generated via the direct or secondary tag on the specific antibody" (ThermoFisher Scientific, 2021).

6) **Polymerase Chain Reaction (PCR)**: PCR can be used for isolating bacterial strains in food samples by amplifying specific segments of DNA *in vitro*. PCR cycles include DNA denaturation, primer annealing, and extension. Moreover, the PCR concept also includes primers, DNA polymerase, nucleotides, specific ions, and DNA template. Food industries usually use Real-Time PCR (also denoted as quantitative PCR—qPCR) because it is fast to produce a high quantity of target DNA sequences in different matrices, and also have higher precision than traditional PCR (Kralik & Ricchi, 2017).
7) **Whole Genome Sequencing (WGS)**: From the CDC definition, "WGS is a laboratory procedure that determines the order of bases (A, T, C, and G in DNA sequences) in the genome of an organism in one process." Each organism has a different DNA sequence. WGS can identify pathogens of foodborne illnesses with higher accuracy and less time compared to Pulsed-Field Gel Electrophoresis (PFGE). WGS involves four main steps: (1) DNA shearing, (2) DNA bar-coding, (3) Whole genome sequencing, and (4) Data

analysis. The CDC has been using WGS since 2013 to detect foodborne illness outbreaks caused by *Listeria monocytogenes*. Currently, scientists use the WGS technique to detect outbreaks from other foodborne pathogens, such as *Campylobacter*, Shiga toxin-producing *E. coli* (STEC), and *Salmonella* (CDC, 2016).

Laboratory results from food sampling are used to determine the safety of food and the extent of contamination in food production. Therefore, the laboratories must ensure that their analyses are performed effectively and efficiently.

Chapter 2 - Learning Objectives and Project Description

During the Summer and Fall of 2020, and due to the constraints of the COVID-19 pandemic, the author was privileged to pursue an *online* field experience. The author's advisor, Dr. Kastner, introduced the author to a group of mentors with particular expertise in the field experience's various objectives. These mentors included Dr. Lorenzo Terzi (an European Union official based in Washington, D.C.), Dr. Kanyarat (Bo) Saensukjaroenphon (a Thailand government official, and recent KSU MPH graduate), Mr. Mike Fink (meat and poultry inspection, Kansas Department of Agriculture), and a member of my KSU faculty supervisory committee—Dr. Valentina Trinetta, a food microbiologist. These special mentors (and a few others to whom they introduced me) enabled the author to pursue the following learning objectives and field experience activities:

2.1 Learning Objectives:

1. To explore and summarize regulations of current importance in the Thailand-EU agri-food trade
2. To learn about Kansas food safety regulations for a wide array of protein/animal sources, and the kinds of laboratory testing involved in such regulatory activities
3. To conduct a review of the relevance of such scientific standard-setting bodies as the Codex Alimentarius Commission (Codex) and the World Organization for Animal Health (OIE) on the regulatory and trade-policy activities of Thailand

2.2 Field Experience Activities:

1. The author corresponded with my field experience mentor from the European Union to develop A Detailed List of Recommendations for Thai Producers and Exporters while also reading and summarizing EU regulations of trade significance.
2. The author corresponded with a second field experience mentor who is an inspector for the State of Kansas. He and the author conferred by phone and Zoom, and he also pointed the author in the direction of many KDA and USDA regulatory documents. By working with him, the author developed A Table of Food Safety Laws for Kansas.
3. The author developed a Table of Selected Pathogens of Concern in Kansas Food Safety Policies, and Relevant Lab Tests. To create this table, the author selected important pathogens mentioned in Kansas's laws and regulations and also selected other important

foodborne pathogens of high concern in the U.S. In creating this table, the author depended on my mentor Dr. Trinetta and various KDA Laboratory officers.

4. The author corresponded with additional field experience mentors from Thailand's DLD. They gave her information about poultry production and compartmentalization in Thailand. The author created a PowerPoint presentation on the topic of "The relevance of the Codex Alimentarius Commission (Codex) and the World Organization for Animal Health (OIE) for Thailand's poultry export trade." The author prepared this presentation for a guest lecture for Dr. Kastner's DMP 816 *Trade and Agricultural Health* class on April 8, 2021.

The accompanying Applied Practical Experience (APE) document contains the various products that the author created. These included the following:

1. Portfolio product no. 1: A Detailed List of Recommendations for Thai Producers and Exporters (on page no. 9 of the APE report)
2. Portfolio product no. 2A: A Table of Food Safety Laws for Kansas (on page no. 25 of the APE report)
3. Portfolio product no. 2B: A Table of Selected Pathogens of Concern in Kansas food safety policies, and relevant lab tests (on page no. 29 of the APE report)
4. Portfolio Product no. 3: Slide deck for guest lecture on Codex and OIE standards in Thailand's poultry trade (on page no. 37 of the APE report)

Chapter 3 - Reflection, Analysis, and Key Observations

During APE experience, and as the author created the various portfolio products (available in my APE document), she frequently met with Dr. Kastner (during warm weather in the KSU Gardens, and in cold weather via Zoom) to combine her learning with other reflections, analysis, and observations. Below is a description of those selected themes that the author explored and now reflect on.

Figure 3.1 The environs of the KSU Gardens when meeting with Dr. Kastner outdoors in the summer and early fall of 2020.

3.1 Career development learning from mentors

All of the author's mentors, their work, and their experiences related to food safety and the food production system. The author feel really grateful that they gave her information and suggestions during her online field experience in the midst of the Covid-19 pandemic.

Figure 3.2 Dr. Kastner, several veterinary students, and the author met Dr. Lorenzo Terzi in Bologna, Italy in the summer of 2019.

The author met Dr. Lorenzo Terzi in the summer of 2019 through her advisor Dr. Kastner. Currently, Dr. Terzi is an EU Spokesperson for the DG SANTE to the WTO/SPS Committee. The author was excited to work with him as part of this virtual/online field experience. He is a veterinarian and works for the government; his role in Europe is the same as her role in Thailand. He has many experiences in meat inspection and fishery products audits. He also used to be the Head of the unit responsible for compliance with the SPS Agreement. He has knowledge about food safety regulations of the EU and the SPS Agreement because he used to be the Co-Lead Negotiator for the Chapter on SPS Measures of the Free Trade Agreements negotiated by the EU. He also used to be the Minister Counselor, Delegation of the European Union to the United States in Washington, D.C., responsible for Sanitary and Phytosanitary issues. The author asked him many questions about the EU food safety regulations that the author learned for my APE. He is kind and easy to communicate with. From his career development and experiences, he inspired her to work with international organizations like the WTO in the future.

Dr. Valentina Trinetta is a helpful mentor and one of her committee members. She works as an Assistant Professor at the Food Science Institute, KSU. She has many experiences in food microbiology, especially the laboratory research for foodborne pathogens. The author learned many fundamental practices in food microbiology laboratory from her. She is kind, creative, and knowledgeable. The auhthor now understand some important laboratory procedures used to identify foodborne pathogens because of what the author learned from her.

Mr. Mike Fink is a meat inspector at KDA. He has a long time of experience in the food production system. He used to work as a cook for Military and Quality Assurance at a chocolate production company (Russell Stover^{TM}) before working at the KDA. The author have never met him in person because of the Covid-19 pandemic; however, the author communicated with him via email and Zoom. He is kind, works hard, and is knowledgeable. The author asked him many questions, and he answered me thoroughly. The author now understand Kansas's food safety regulations because of him.

Dr. Kanyarat Saensukjaroenphon is a Veterinary Officer at DLD, Thailand. She is her colleague and friend. She has been interested in public health since she was a veterinary student; this is the same for the author because public health has various tasks to deal with different from the veterinary clinic. A veterinarian in Public Health can use multidisciplinary knowledge to apply for work, especially in the food safety field which has many stakeholders involved (e.g., physicians, epidemiologists, microbiologists, and policymakers). She also graduated with a Master of Public Health (MPH) degree from KSU in 2018. She recommended that the author pursue MPH degree at KSU. She has worked at the DLD since 2010. Currently, she works as a Veterinary Inspector to inspect meat processing plants for export. She is kind, reasonable, and knowledgeable. She gave the author a lot of information about exported livestock production in Thailand, and guided the author on how to live in the U.S.

\

Figure 3.3 Dr. Kanyarat Saensukjaroenphon; she is one of the author's mentors for the online field experience.

During the field experience, the author also gained knowledge from several other persons. Several KDA Laboratory officers (Sydney Orel, Microbiology Section Supervisor; Sally Flowers, Laboratory Director; and Victoria Watkins, Feed and Fertilizer Section Supervisor) gave the author information of laboratory procedures to identify the meat and poultry products in Kansas. In addition, the author got the information about compartmentalization in Thailand from Dr. Thiti Antarasena, her colleague from the Bureau of Livestock Standards and Certification (BLSC), DLD.

3.2 General requirements required before KDA inspects facilities

The important responsibility of the KDA meat inspectors is to inspect slaughterhouses and meat processing plants, and ensure their compliance with Kansas's food safety regulations, including the Kansas Meat and Poultry Inspection Act (KMPIA). In the KDA, a field inspection supervisor oversees six field inspectors. From the Fully Inspected State Slaughter and Processing Establishment brochure, there are 28 meat and poultry slaughterhouses and processing plants under KDA inspection which are located in northeast, southeast, northwest, and southwest Kansas (KDA, 2020). New facilities will be approved by the field supervisor and the field inspection supervisor. If a new establishment is approved, an establishment will be assigned by the KDA

Office Manager, Krista Moore. Establishment numbers are system-generated, usually the number following the last establishment number recorded in the KDA system. In some cases, the KDA allows the producers to choose their own number if the preferred number is not yet in use. Using the old number is also allowed if the establishment used to be under the federal inspection and had a previously-assigned number. Before new establishments will be approved, they must submit the documents required by the KDA, and follow general requirements mentioned in the Appendix of this report.

3.3 The interesting case of *Staphylococcus aureus* and its absence in KDA inspection protocols

In Kansas, the KDA follows the FSIS sampling plan. Meat inspectors collect samples of meat and meat products. The KDA Laboratory tests the samples and reports the laboratory results to meat inspectors. The Microbiology/Meat laboratory section of the KDA Laboratory tests meat and meat products' samples for the Meat and Poultry Inspection program in two categories: pathogen and routine samples.

Samples for pathogen tests consist of raw meat, ready-to-eat meat products, poultry rinses, and environmental samples from production facilities. Fresh ground meat is checked for *Salmonella* spp. and *E. coli* O157:H7. Trim samples are analyzed for *E. coli* O157:H7 and the "big six" non-O157 Shiga Toxin producing *E. coli* strains (STECs). Poultry rinses are tested for *Salmonella* spp. and *Campylobacter jejuni/coli/lari*. Ready-to-eat meat products are tested for *Salmonella* spp. and *Listeria monocytogenes*. The environmental samples, which are swab samples from meat processing facilities, are tested for *Listeria monocytogenes*. Samples for routine tests include raw or ready-to-eat meat samples that are analyzed for fat, protein, and moisture content (Kansas Department of Agriculture, n.d.). The author and her advisor find it interesting that the sampling plan does not require for *Staphylococcus aureus* test. Moreover, the KDA Laboratory does not perform any routine screening test for *S. aureus*. This pathogen may have less concerns than other foodborne pathogens. Developing severe illnesses from *S. aureus* enterotoxin rarely occurs, and people can usually recovery within a day. Enterotoxins produced *by S. aureus* can be tested from stool, vomit, and foods. However, the toxin tests are usually performed during an outbreak investigation, and they are not required in routine tests (CDC, 2018a). *S. aureus* can be found in ready-to-eat food products, but there is no specific regulatory

requirements for RTE foods to control *S. aureus* (Food Safety and Inspection Service, 2012, p. 20). *S. aureus* can also contaminate meat via animal skin or tissue during slaughtering processes (e.g., hide removal, gutting). Despite these possible hazards, the FSIS has stated that "*S. aureus* is not a good competitor with other microorganisms and is usually not a problem in raw foods" (Food Safety and Inspection Service, 2012, p. 21).

Staphylococcus aureus is a gram-positive, cocci, facultative anaerobe, non-motile, non-spore forming bacteria. *S. aureus* is normally found in nasal passages and on human skin, but does not cause illness in healthy people. Anyone who consumes foods contaminated by *S. aureus* toxins may suffer from food poisoning. Food handlers who carry *S. aureus* can contaminate food if they do not wash their hands properly. *S. aureus* will multiply in food and produce the heat-stable enterotoxin. Foods that are not cooked after handling are risky when contaminated with *S. aureus* such as sliced meats, puddings, pastries, and sandwiches. People who get foodborne illness from *S. aureus* will develop symptoms within 30 minutes to 8 hours after eating contaminated foods. The symptoms includes nausea, vomiting, and stomach cramps. Some people can also develop diarrhea. The symptoms can subside quickly (CDC, 2018a).

3.4 The unique challenge and opportunity of Thailand's compliance with EU regulatory requirements

In January 2004, High Pathogenic Avian Influenza (HPAI) outbreaks occurred in Thailand. HPAI is a zoonotic disease and calamitous disease in poultry caused by HPAI viruses that can transmit from poultry to humans. This outbreak caused 17 human deaths from 2004 to 2006. (Chunsuttiwat, 2008). More than 62 million birds were either killed by HPAI viruses or culled. Because of this outbreak, many countries banned poultry meat and poultry products from Thailand causing damage to Thailand's poultry industry (Tiensin et al., 2005). The European Union (EU) prohibited the import of poultry products from Thailand on January 23, 2004 due to HPAI outbreaks as recorded in the "Commission Regulation (EC) No 798/2008 of 8 August 2008 laying down a list of third countries, territories, zones or compartments from which poultry and poultry products may be imported into and transit through the Community and the veterinary certification requirements" (European Commission, 2008, p. L226/13). The Thai government made an effort to control this outbreak in both human and animal health. For human health, the Ministry of Public Health (MOPH) conducted public health education and risk communication campaigns to educate

people, especially in the risk group (i.e., poultry farmers and rural people), about HPAI infection and disease prevention. For animal health, the Department of Livestock Development (DLD), Ministry of Agriculture and Cooperative (MOAC) is the competent authority to control animal diseases. DLD used active and passive surveillance for 10 kilometers around the outbreak. To control this outbreak, officials culled infected birds or flocks and compensated farmers. The official also directed movement control, disinfection in all poultry farms, and improvement of biosecurity in poultry farms.

Significantly, in 2005 the DLD began to pursue compartmentalization following the World Organization for Animal Health (OIE)'s guidelines mentioned in the *Terrestrial Animal Health Code*; for more on Thailand's commitment to compartmentalization, see the next section (3.5). The Thai people followed the recommendations from MOPH along with effective poultry outbreak prevention and control resulting in no reported human illnesses or deaths from HPAI in Thailand in 2007 (Chunsuttiwat, 2008). Because of applied effective control measures and prevention, there were only a few occurrences in 2006-2008. Each outbreak in 2006-2008 only occurred in a single household. It dramatically decreased from 853 outbreaks in 60 provinces in 2004 to 4 outbreaks in 4 provinces in 2008 as shown in Figure 3.4. The last outbreak occurred in November 2008. After that, the DLD collected serum samples and cloacal swab tests for HPAI, and all results were negative. Therefore, the OIE Delegate of Thailand declared that "the country regained its freedom from HPAI in domestic poultry as of February 11, 2009 in accordance to with Article 10.4.4. of the OIE *Terrestrial Code* (2008)"(Department of Livestock Development, 2009).

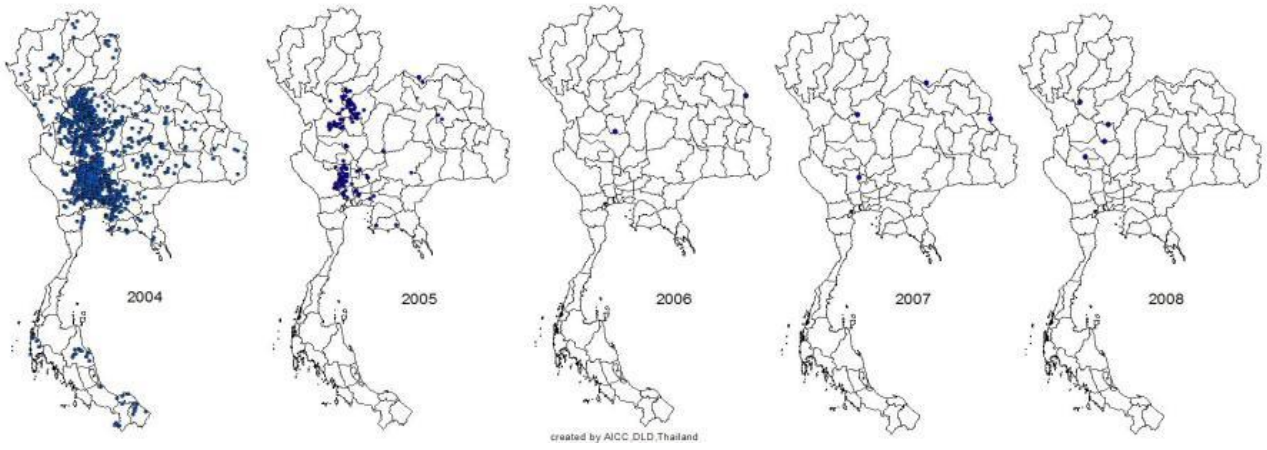

Figure 3.4 The distribution of HPAI (H5N1) outbreaks in Thailand from 2004 to 2008.

Source: Antarasena, Thiti. "Personal Communication regarding Poultry Compartment in Thailand." Bureau of Livestock Standards and Certification: Department of Livestock Development, 25 January 2021.

After the HPAI outbreaks in Thailand were over, the EU has allowed country members to import raw poultry meat products from Thailand again (since July 1, 2012, as mentioned in the "commission implementing Regulation (EU) No 393/2012 of 7 May 2012 amending Annex I to Regulation (EC) No 798/2008 as regards the entry for Thailand in the lists of third countries or parts thereof from which poultry and poultry products may be imported into and transit through the Union" (European Commission, 2012, p. L123/29)).

3.5 Compartmentalization in Thailand: A story of complex implementation

The OIE introduced the zoning and compartmentalization concept in the *Terrestrial Animal Health Code* (fourteen edition) in 2005 (Ratananakorn & Wilson, 2011, p. 298). Zoning and compartmentalization help to facilitate safe trade and comply with the WTO *Agreement on the Application of Sanitary and Phytosanitary Measures* (the SPS Agreement).

From the OIE definition, "Zoning applies to an animal subpopulation defined primarily on a geographical basis. Compartmentalization applies to an animal subpopulation defined primarily by management and husbandry practices related to biosecurity. In practice, spatial considerations and appropriate management, including biosecurity plans, play important roles in the application of both concepts*"* (World Organization for Animal Health, 2019).

The glossary of the Terrestrial Code 2019 defines a "compartment" as "an animal subpopulation contained in one or more establishments, separated from other susceptible populations by a common biosecurity management system, and with a specific animal health status with respect to one or more infections or infestations for which the necessary surveillance, biosecurity and control measures have been applied for the purposes of international trade or disease prevention and control in a country or zone."

"Biosecurity plan" is defined in the Terrestrial Code 2019 as "a plan that identifies potential pathways for the introduction and spread of disease in a zone or compartment, and describes the measures which are being or will be applied to mitigate the disease risks, if applicable, in accordance with the recommendations in the Terrestrial Code."

After HPAI outbreaks in Thailand in 2004, raw poultry meat was banned from importation by some of Thailand's trading partners. This was devastating for the Thai poultry industry. The Thai government collaborated with poultry producers to control Avian Influenza diseases to gain trust and export raw poultry meat again. Thailand adopted the OIE compartmentalization concepts in 2006 as a part of control measures to control Notifiable Avian Influenza (NAI)[4] disease in poultry. Its first initiative was called "the NAI free compartment." The DLD collaborated with relevant stakeholders and experts from MOPH to implement compartmentalization in the poultry commodity area. The DLD is responsible for certifying establishments that comply with the NAI free compartment. In 2006, DLD certified the compartment *only* for broiler and meat-type duck establishment because these exported commodities were most affected by the NAI outbreaks. In 2011, the DLD certified a compartment for breeder poultry, hatcheries, poultry feed mills, and poultry slaughterhouses (Antarasena, 2021). Table 3.1 shows the number of certified NAI-free compartments in Thailand's poultry sector in 2020. The OIE zoning and compartmentalization concepts were incorporated into Thailand's regulations and standards in the following policies:

- Notification of the Department of Livestock Development: Notifiable Avian Influenza - Free Compartmentalization. B.E. 2560 (2017)
- TAS 9038-2013: Principles for Establishment of Notifiable Avian Influenza Free Compartmentalization for Poultry Farms.
- TAS 9033-2010: Principles for Establishment of Compartmentalization for Livestock.

As indicated below (Table 3.1 and Figures 3.5, 3.6, and 3.7), the process of implementing compartmentalization is both important and cumbersome. As the author explains in her lecture slide deck (portfolio product no. 3, in the appendix of the APE report), many conditions must be satisfied to properly implement compartmentalization. Especially interested readers of this ILE report are encouraged to review the APE's appendix and the various slides created by the author; however, the tables and figures below provide the reader with a sense of the overall complexity (and challenge!) of implementing compartmentalization. It is no easy task!

[4] Notifiable Avian Influenza (NAI) includes two particular subtypes, H5 and H7 that must be reported to the OIE.

Table 3.1 The number of certified NAI free compartments in Thailand's poultry sector in 2020

Type of poultry	Number of farms
Duck-type meat	8
Breeder ducks	7
Broilers	203
Breeder chickens	31
Hatcheries	9
Total	**258**

Source: Antarasena, Thiti. "Personal Communication regarding Poultry Compartment in Thailand." Bureau of Livestock Standards and Certification: Department of Livestock Development, 25 January 2021.

Figure 3.5 Disinfection of all vehicles before entering the farm.

Figure 3.6 Thorough cleaning and disinfecting of a poultry house after flock harvesting.

Figure 3.7 Visitors wearing PPE provided by the farm.

Source: Antarasena, Thiti. "Personal Communication regarding Poultry Compartment in Thailand." Bureau of Livestock Standards and Certification: Department of Livestock Development, 25 January 2021.

3.6 The EU's microbiological criteria for raw milk

The EU annually produces around 155 million tons of milk. The major producers of EU milk production are Germany, France, Poland, the Netherlands, Italy, and Spain. The EU ranks first in the world for exporting cheese and skimmed milk powder (European Commission, n.d.). (The author's supervisor, a fan of Toblerone chocolate, notes that the milk powder used in its production comes from Switzerland, which is *not* a member of the EU.) One of the biggest controversies in food safety is the suitability of *raw* milk products in commerce; therefore, the author of this ILE will reflect on how the EU accommodates this issue, which is interesting.

The microbiology criteria for raw milk in the EU can be found in the "Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific hygiene rules for food of animal origin," annex III, section IX: Raw milk and Dairy Products. This regulation defines raw milk as "milk produced by the secretion of the mammary gland of farmed animals that has not been heated to more than 40ºC or undergone any treatment that has an equivalent effect" (European Parliament, Council of the European Union, 2019, p. 37).

According to the EU regulation, raw milk must come from healthy animals, with no sign of contagious diseases that might contaminate the milk or be transmissible to humans; in addition, there must not be any udder wounds, and no drug residues. Both the equipment and the premises in milk production must be routinely and systematically cleaned and disinfected. The equipment's material must be non-toxic, smooth, and easy to clean. The animal's udder must be cleaned and test individually before milking. Milk should be kept in the clean container and cooled down the temperature to not more than 8 °C in the case of daily collection, or not more than 6 °C if collection is not daily. Temperature during transportation of milk is not more than 10°C. Production staff who come into contact with the raw milk must maintain good personal hygiene. Moreover, food business operators must test for drug residues in the raw milk to ensure that the residues will not exceed a prescribed limit. The following are some of the microbiological criteria against which samples are tested:

- Criteria for raw cows' milk: Plate count at 30°C ≤ 100,000 cfu/ml, Somatic cell count ≤ 400,000 cells per ml
- Criteria for raw milk from other species: Plate count at 30°C ≤ 1,500,000 cfu/ml**,** but for use with no heat treatment: Plate count at 30 °C ≤ 500,000 cfu/ml

Since raw milk safety is a controversial issue, EU member countries may make individual decisions to ban or restrict the sale of raw milk intended for human consumption in their economies. The author is, honestly, alarmed that some EU member countries permit the sale of raw milk via vending machines. Fortunately, the European Food Safety Authority insists on being careful; consumers should boil raw milk before consumption because raw milk is a source of foodborne pathogens (European Food Safety Authority, 2015).

Milk is an important agricultural product in the U.S., too. In 2020 around 17.9 billion pounds of milk are produced from 24 states (National Agricultural Statistics Service, 2020). As in the European Union, the sale of raw milk is a controversial topic in the U.S. In 1987, the FDA issued a regulation to prohibit selling raw milk across state lines (Food and Drug Administration, 2011). Milk sold interstate must be pasteurized and must comply with the standards of the Pasteurized Milk Ordinance (PMO). However, some states do in fact allow farmers to sell raw milk legally within their state. Dairy regulations vary from state to state (Milk Facts, n.d.). For example, some states are allowed to sell raw milk in retail stores (e.g., in Arizona, California, Nevada, Pennsylvania, and Washington), some states permit raw milk sales only on farms on which the milk is produced (e.g., in Minnesota, Nebraska, Kansas, New York, and Texas), and some states do not allow the sale of raw milk for human consumption (e.g., in Iowa, Colorado, New Jersey, Florida, Georgia, and Hawaii) (ProCon.org, 2016). The following are some of the microbiological criteria used for raw cows' milk in the United States:

- Pre-pasteurized milk for Grade A use: total bacteria $\leq$ 100,000 cfu/ml for individual producer and $\leq$ 300,000 cfu/ml for commingled milk.[5] Somatic cell count $\leq$ 750,000 cells/ml
- Raw milk intended for consumption: total bacteria $\leq$ 30,000 cfu/ml, Somatic cell count $\leq$ 750,000 cells/ml. Drug residues in milk must not be positive.

[5] Commingled milk is milk that has left the farm and has been mixed with other individual producer's milk in a tank, either during shipment or at the processing plant.

3.7 A selected EU regulation of interest

The author is a veterinary officer in the DLD, Thailand. She is responsible for auditing slaughterhouses, meat processing plants, and pet food processing plants. Her responsibilities are usually focused on livestock products, especially poultry meat and pork. However, she also was interested to learn about the safety of seafood products, which in Thailand are regulated by the Department of Fishery. She was given a great opportunity to begin this quest by joining the iMOVES program in the summer of 2019 with other students from various universities (e.g. KSU, CSU, PSU, TAMU, and UniPD). During the program, she visited a seafood company named "Fiorital" and observed its operation. The facilities are located on a bank in Venice, Italy.

Figure 3.8 The loading docks of the seafood processing company "Fiorital," in Venice, Italy

Figure 3.9 A group of veterinary students including the author pose for a photo with the Fiorital Company's staff in Venice, Italy.

Before entering Fiorital's processing areas, Dr. Valerio Giaccone (Department of Animal Medicine, Production and Health, University of Padova) gave a lecture on food safety and hygiene of fishery products. The facilities included a raw material receiving area, cutting area, chilled room, freezers, cooking area, packing area, and loading area. The equipment, processing practices, and facilities were clean, and certainly well-maintained. Based on this initial experience with Fiorital, the author was inspired to further explore EU regulations related to the safety of fishery products.

Figure 3.10 Dr. Valerio Giaccone's lecture at Fiorital Company, Venice, Italy.

Fishery product companies must comply with the "Regulation (EC) No 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs" in term of the general of good hygiene practices and Hazard Analysis and Critical Control Point (HACCP) expectations outlined in the Codex Alimentarius Commission guidelines. In addition, fishery products must comply with specific requirements mentioned in section VIII, Annex III of the "Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific hygiene rules for food of animal origin" about Fishery products (European Parliament, Council of the European Union, 2019). The full text of the regulation is quite lengthy, but the following are some of the key requirements of the regulation:

- During and after landing fishery products: Food business operators must ensure that the material equipment used for unloading and landing fishery products is easy to clean and disinfect. All equipment must be clean and in a good condition. Fishery products must be kept at cool temperatures as soon as possible, and in areas shielded from contamination. Food business operators must cooperate with relevant competent authorities to conduct

official controls (e.g., document checking, inspecting, and sampling) for the landing of fishery products.

- Requirements for establishments, including vessels, handling fishery products: Fresh products that are chilled and unpackaged must be stored under ice in proper facilities. Packaged fishery products must be kept at a cool temperature approaching that of melting ice. Food business operators must do "re-icing" if necessary. Heading and gutting operations must be performed in a hygienic manner. Clean potable water must be used to wash products after gutting. Filleting and cutting operations must avoid contamination. Fillets and slices must be wrapped or packaged, and chilled as soon as possible. Unpackaged prepared fresh fishery products' storage containers must drain melted water from the ice. For frozen products, food business operator must have freezing equipment to lower the core temperature of products to not greater than -18ºC, and have refrigeration storage to maintain the core temperature of products to not greater than -18ºC. The storage room must have a temperature-recording device to show the current temperature. For mechanically separated fishery products, raw materials must be free from entrails or guts. Mechanical separation must take place after filleting. Mechanically separated fishery products must be frozen after production. Fishery products intended for raw consumption *must* be frozen at a temperature of not greater than -20 °C; this requirement must be maintained in all parts of the product for not less than 24 hours (except for those products that can demonstrate no presence of pathogens or parasites).

- Other requirements focus on proper cooking and post-cooking storage requirements for crustaceans and mollusks, histamine and toxin control parameters, packaging requirements, and transportation temperature requirements.

Chapter 4 - Competencies

Student Attainment of MPH Foundational Competencies

The author is grateful for all of my coursework; KSU has encouraged her to grow as a scholar in all of these competency areas. Of course, the APE experience allowed her to further enhance a subset of these competencies. Below, in table 4.1, the author describe and elaborate on how specific APE activities helped her grow in these competency areas.

Table 4.1 Summary of MPH Foundational Competencies Table

Number and Competency		**Description (APE activity and/or product)**
5	Compare the organization, structure and function of health care, public health and regulatory systems across national and international settings	I work as a veterinary officer for the government of Thailand located in South-East Asia. I was eager to learn about food safety regulations in operation in other countries. With that goal in mind, during my online field experience, I explored food safety regulations in the European Union and the U.S (specifically, Kansas) by working with EU veterinary and Kansas meat inspection officials. My learning has been documented in portfolio product no. 1 (list of recommendations based on the EU regulations), product 2A (A Table of Food Safety Laws for Kansas), and product 2B (A Table of Selected Pathogens of Concern in Kansas food safety policies, and relevant lab tests). Moreover, I also explored the special role that international standards (from the Codex Alimentarius Commission and the World Organization for Animal health or OIE) play in Thailand's poultry production and trade; for this activity, I created a PowerPoint presentation, as indicated in portfolio product no. 3.
16	Apply principles of leadership, governance and management,	For portfolio product no. 1, I exercised leadership by creating a list of recommendations for Thai producers

Number and Competency		Description (APE activity and/or product)
	which include creating a vision, empowering others, fostering collaboration and guiding decision making	and exporters. These recommendations were generated based on my studies (and conversations, with an EU official). My home country's producers and exporters of meat products must understand and comply with those regulations if they want to export meat products to the EU. This learning experience has enabled me to be a better leader in my home country, where I work in the government.
18	Select communication strategies for different audiences and sectors	I created a list of recommendations for Thai producers and exporters. These recommendations will help them understand what they should know about the EU food safety regulations as indicated in portfolio product no. 1. I created a PowerPoint presentation for graduate students at KSU. These students come from several backgrounds and are likely unfamiliar with Thailand regulations and how Thailand adopted or adapted Codex and OIE international standards. This presentation was useful for another reason: to educate them on the application of compartmentalization in Thailand's poultry sector. Developing recommendations for Thai producers and developing a presentation for KSU students required different approaches for these different audiences.
19	Communicate audience-appropriate public health content, both in writing and through oral presentation	Both portfolio products no. 1 (a list of recommendations for Thai producers and exporters, a unique audience with which I am familiar) and no. 3 (a PowerPoint presentation on Codex and OIE standards in Thailand's poultry trade for KSU students, a unique audience unfamiliar with Thailand), required me developing information for different audiences.

Number and Competency		Description (APE activity and/or product)
21	Perform effectively on interprofessional teams	I communicated with multiple mentors (each professional in government at different levels in different workplaces) via email, WhatsApp, Line, and Zoom, often asking them questions if I did not understand some of the regulations. I also met weekly with Dr. Kastner to discuss what I was learning. Moreover, I combined my learning in the Food Microbiology Laboratory with Dr. Trinetta. In these situations, I always worked collaboratively with different people, and one of the best examples of this is my portfolio product 2B, which integrated what I learned from these different people.

The author completed core MPH courses touching on competencies listed in Table 4.2.

Table 4.2 MPH Foundational Competencies and Course Taught In

22 Public Health Foundational Competencies Course Mapping	MPH 701	MPH 720	MPH 754	MPH 802	MPH 818
Evidence-based Approaches to Public Health					
1. Apply epidemiological methods to the breadth of settings and situations in public health practice	x		x		
2. Select quantitative and qualitative data collection methods appropriate for a given public health context	x	x	x		
3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate	x	x	x		
4. Interpret results of data analysis for public health research, policy or practice	x		x		
Public Health and Health Care Systems					
5. Compare the organization, structure and function of health care, public health and regulatory systems across national and international settings		x			
6. Discuss the means by which structural bias, social inequities and racism undermine health and create					x

22 Public Health Foundational Competencies Course Mapping	MPH 701	MPH 720	MPH 754	MPH 802	MPH 818
challenges to achieving health equity at organizational, community and societal levels					
Planning and Management to Promote Health					
7. Assess population needs, assets and capacities that affect communities' health		x		x	
8. Apply awareness of cultural values and practices to the design or implementation of public health policies or programs					x
9. Design a population-based policy, program, project or intervention			x		
10. Explain basic principles and tools of budget and resource management		x	x		
11. Select methods to evaluate public health programs	x	x	x		
Policy in Public Health					
12. Discuss multiple dimensions of the policy-making process, including the roles of ethics and evidence		x	x	x	
13. Propose strategies to identify stakeholders and build coalitions and partnerships for influencing public health outcomes		x		x	
14. Advocate for political, social or economic policies and programs that will improve health in diverse populations		x			x
15. Evaluate policies for their impact on public health and health equity		x		x	
Leadership					
16. Apply principles of leadership, governance and management, which include creating a vision, empowering others, fostering collaboration and guiding decision making		x			x
17. Apply negotiation and mediation skills to address organizational or community challenges		x			
Communication					
18. Select communication strategies for different audiences and sectors	DMP 815, FNDH 880 or KIN 796				
19. Communicate audience-appropriate public health content, both in writing and through oral presentation	DMP 815, FNDH 880 or KIN 796				
20. Describe the importance of cultural competence in communicating public health content		x			x
Interprofessional Practice					
21. Perform effectively on interprofessional teams		x			x
Systems Thinking					
22. Apply systems thinking tools to a public health issue			x	x	

Student Attainment of MPH Emphasis Area Competencies

The author's emphasis area is Food Safety and Biosecurity in the Master of Public Health (MPH) program. The APE and the ILE enhanced her learning regarding food safety standards applied in different countries, and she also learned about international food safety standards essential the public health in specific nations and globally. During her field experience activities, she was able to strengthen her knowledge and competencies, as shown in Table 4.3 below.

Table 4.3 Summary of MPH Emphasis Area Competencies

MPH Emphasis Area: Food Safety and Biosecurity		
Number and Competency		**Description**
1	Food safety and biosecurity	I learned food safety standards that apply in the EU, U.S., and Thailand. There are many regulations and standards for food safety because those standards need to cover every stage of the food chain from production to harvest, processing, storage, and distribution to consumers. Food safety and biosecurity's primary goal is to enhance protection of human, animal life and health, while also facilitating trade. Laboratory procedures can help to determine whether food is safe for consumption.
2	Threats to the food system	Both national and international food economies can introduce threats to the food system. Threats can be animal diseases, physical hazards, chemical hazards, and biological hazards, especially when foodborne pathogens contaminate the food system. Such contamination can happen intentionally and unintentionally. Food safety regulations and standards can reduce the risk of these threats to harm public health. Laboratory procedures offer essential tools to identify threats, including pathogens, chemical residues, and diseases.

MPH Emphasis Area: Food Safety and Biosecurity		
Number and Competency		**Description**
3	Food safety laws and regulations	During my online field experience, I explored many food safety regulations and standards applicable in the EU, U.S. (the State of Kansas), and Thailand. I also learned about international standards (e.g., OIE, Codex standards). Codex standards are the reference standards for food safety regulations. Moreover, I also learned more about government organizations responsible for food safety regulation in the U.S. Both federal policy and individual states' (including Kansas's) policies play important roles in food safety.
4	Food safety policy and the global food system	Globalization enhances the growth of international trade, which can also introduce hazards (including animal diseases, foodborne pathogens, and plant diseases) to importing countries. Good food safety policy can help to reduce some of the specifically human health risks. Nations still need to exchange food products to meet consumer demand and protect the way of life. Therefore, nations should adopt the international standards set by OIE, Codex, or IPPC; by incorporating these standards into their countries' regulations (and by accepting other nations' food safety standards that are equivalent), *both* trade and health can be facilitated.
5	Multidisciplinary leadership	Food safety regulations that I learned during the online field experience require collaboration from many stakeholders. For example, policymakers must establish food standards that comply with international standards. The government officers (e.g., auditor, inspector) must

MPH Emphasis Area: Food Safety and Biosecurity		
Number and Competency		**Description**
		control or inspect food producers to ascertain whether they comply with the regulations. The food producers or exporters must produce safe food following the regulations or standards. The scientists in the laboratory are responsible for detecting the hazards that can be found in food, following effective methods. I exercised leadership by creating a list of recommendations for Thai producers and exporters. They must understand and comply with those regulations if they want to export meat products to the EU. The learning and experiences that I gained have equipped me with additional confidence and leadership skills for performing my job as a governmental veterinary officer in Thailand. Producing a PowerPoint presentation on Codex and OIE standards in Thailand's poultry trade for the purpose of sharing information to KSU students served as a way for me to improve my information dissemination practice, in the hopes of effectively conveying important information to different audiences.

References

ACFS. (2017). *Food Control System in Thailand: Current Situation and Challenges for Food Safety Modernization or Enhancement*. http://mddb.apec.org/Documents/2017/SCSC/FSCF-EM/17_scsc_fscf_em1_017.pdf

Boundless. (2021, January 3). *6.3A: Culture Media*. Biology LibreTexts. https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/6%3A_Culturing_Microorganisms/6.3%3A_Culturing_Bacteria/6.3A%3A_Culture_Media

Bunmee, T., Chaiwang, N., Kaewkot, C., & Jaturasitha, S. (2018). Current situation and future prospects for beef production in Thailand—A review. *Asian-Australasian Journal of Animal Sciences, 31*(7), 968–975. https://doi.org/10.5713/ajas.18.0201

CDC. (2013, January 29). *Attribution of Foodborne Illness, 1998-2008—Images | Estimates of Foodborne Illness | CDC*. Centers for Disease Control and Prevention. https://www.cdc.gov/foodborneburden/attribution-image.html

CDC. (2016, February 11). *Whole Genome Sequencing (WGS) | PulseNet Methods| PulseNet | CDC*. Centers for Disease Control and Prevention. https://www.cdc.gov/pulsenet/pathogens/wgs.html

CDC. (2018a, August 9). *Staphylococcal Food Poisoning*. Centers for Disease Control and Prevention. https://www.cdc.gov/foodsafety/diseases/staphylococcal.html

CDC. (2018b, November 19). *Burden of Foodborne Illness: Findings | Estimates of Foodborne Illness | CDC*. Centers for Disease Control and Prevention. https://www.cdc.gov/foodborneburden/2011-foodborne-estimates.html

Chunsuttiwat, S. (2008). Response to avian influenza and preparedness for pandemic influenza: Thailand's experience. *Respirology, 13*(s1), S36–S40. https://doi.org/10.1111/j.1440-1843.2008.01256.x

Congressional Research Service. (2021). *Major Agricultural Trade Issues in the 117th Congress*. Congressional Research Service. https://crsreports.congress.gov/product/pdf/R/R46653

Dang, X. P. (2017, January 3). *Dairy Production and Trade in Thailand*. FFTC Agricultural Policy Platform (FFTC-AP). https://ap.fftc.org.tw/article/1157

Department of Livestock Development. (2009). *Self-declaration of the recovery of freedom from highly pathogenic avian influenza (HPAI) by Thailand Declaration*.

Department of Livestock Development. (2017, December 6). *Ensuring quality, safety and ethics*. http://en.dld.go.th/index.php/en/focus-menu/food-safety-menu/107-ensuring-quality-safety-and-ethics

European Commission. (n.d.). *Milk and dairy products* [Text]. European Commission - European Commission. Retrieved February 24, 2021, from https://ec.europa.eu/info/food-farming-fisheries/animals-and-animal-products/animal-products/milk-and-dairy-products_en

European Commission. (2008). Commission Regulation (EC) No 798/2008 of 8 August 2008 laying down a list of third countries, territories, zones or compartments from which poultry and poultry products may be imported into and transit through the Community and the veterinary certification requirements. *Official Journal of the European Union*, L 226/1-L226/94. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R0798&qid=1594653431847&from=EN

European Commission. (2012). Commission Implementing Regulation (EU) No 393/2012 of 7 May 2012 amending Annex I to Regulation (EC) No 798/2008 as regards the entry for Thailand in the lists of third countries or parts thereof from which poultry and poultry products may be imported into and transit through the Union. *Official Journal of the European Union*, L 123/27-L123/29. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0393&qid=1594654917077&from=EN

European Commission. (2019, July 18). *Poultry* [Text]. https://ec.europa.eu/info/food-farming-fisheries/animals-and-animal-products/animal-products/poultry_en

European Commission. (2021). *Health and Food Safety* [Text]. European Commission - European Commission. https://ec.europa.eu/info/departments/health-and-food-safety_en

European Commission, Directorate-General for Health and Food Safety. (2020). *Final report of an audit carried out in Thailand from 28 January 2020 to 7 February 2020 in order to evaluate the animal health controls in place in relation to export of meat, eggs and products thereof to the European Union*. https://ec.europa.eu/food/audits-analysis/audit_reports/details.cfm?rep_id=4292

European Food Safety Authority. (2015, January 13). *Raw drinking milk: What are the risks?* European Food Safety Authority. https://www.efsa.europa.eu/en/press/news/150113

European Parliament, Council of the European Union. (2019). Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004 Laying Down Specific Hygiene Rules for Food of Animal Origin. *Official Journal of the European Union*, 1–80. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02004R0853-20190726&qid=1594154497064&from=EN

Food and Drug Administration. (2011). Raw milk questions & answers. *FDA.* https://www.fda.gov/food/buy-store-serve-safe-food/raw-milk-questions-answers

Food Safety and Inspection Service. (2012). *Introduction to the Microbiology of Food Processing*. United States Department of Agriculture. https://www.fsis.usda.gov/shared/PDF/SPN_Guidebook_Microbiology.pdf

Jennings, S., Ministry of Agriculture and Forestry (MAF), & Biosecurity New Zealand. (2011). *Procedural Step-by-Step Manual for SPS National Notification Authorities and SPS National Enquiry Points*. https://www.wto.org/english/res_e/booksp_e/sps_procedure_manual_e.pdf

Kansas Department of Agriculture. (n.d.). *Microbiology-Meat Laboratory*. Kansas Department of Agriculture. Retrieved October 19, 2020, from https://agriculture.ks.gov/divisions-programs/ag-lab/microbiology-meat-laboratory

KDA. (2016a). *General Information*. Kansas Department of Agriculture. https://agriculture.ks.gov/divisions-programs/meat-and-poultry-inspection/general-information

KDA. (2016b). *Meat and Poultry Inspection*. Kansas Department of Agriculture. https://agriculture.ks.gov/divisions-programs/meat-and-poultry-inspection

KDA. (2020). *Fully Inspected State Slaughter and Processing Establishment*. https://agriculture.ks.gov/docs/default-source/default-document-library/fully-inspected-plant-brochure.pdf?sfvrsn=584e93c1_0

KDA. (2021, January 29). *USDA - National Agricultural Statistics Service—Kansas—Livestock Releases*. Kansas Department of Agriculture. https://www.nass.usda.gov/Statistics_by_State/Kansas/Publications/Livestock_Releases/index.php

Kralik, P., & Ricchi, M. (2017). A Basic Guide to Real Time PCR in Microbial Diagnostics: Definitions, Parameters, and Everything. *Frontiers in Microbiology*, *8*. https://doi.org/10.3389/fmicb.2017.00108

Milk Facts. (n.d.). *Microbial Standards for Milk | MilkFacts.info*. Milk Facts. Retrieved February 23, 2021, from http://milkfacts.info/Milk%20Microbiology/Microbial%20Standards.htm

National Agricultural Statistics Service. (2020). *Milk production*. United States Department of Agriculture. https://www.nass.usda.gov/Publications/Todays_Reports/reports/mkpr0220.pdf

Netherlands Embassy. (2016). *The Poultry Sector in Thailand*. https://www.rvo.nl/sites/default/files/2016/12/FACTSHEET-POULTRY-SECTOR-IN-THAILAND.PDF

Netherlands Embassy in Bangkok. (2016, December). *The Poultry Sector in Thailand*. https://www.rvo.nl/sites/default/files/2016/12/FACTSHEET-POULTRY-SECTOR-IN-THAILAND.PDF

ProCon.org. (2016, April 19). *Raw milk laws state-by-state*. ProCon.Org. https://milk.procon.org/raw-milk-laws-state-by-state/

Ratananakorn, L., & Wilson, D. (2011). *Zoning and compartmentalisation as risk mitigation measures: An example from poultry production*. *30*(1), 297–307. https://doi.org/10.20506/rst.30.1.2029

Tantasuparuk, W., & Kunavongkrit, A. (2014). PIG PRODUCTION IN THAILAND. *Country Report*, 9. http://www.agnet.org/htmlarea_file/activities/20140314102754/CR%201%20Dr.%20Wichai%20Tantasuparuk.pdf

ThermoFisher Scientific. (2021). *Overview of ELISA - US*. ThermoFisher Scientific. //www.thermofisher.com/us/en/home/life-science/protein-biology/protein-biology-learning-center/protein-biology-resource-library/pierce-protein-methods/overview-elisa.html

Tiensin, T., Chaitaweesub, P., Songserm, T., Chaisingh, A., Hoonsuwan, W., Buranathai, C., Parakamawongsa, T., Premashthira, S., Amonsin, A., Gilbert, M., Nielen, M., & Stegeman, A. (2005). Highly Pathogenic Avian Influenza H5N1, Thailand, 2004.

Emerging Infectious Diseases, *11*(11), 1664–1672. https://doi.org/10.3201/eid1111.050608

Trinetta, V. (2020). *Laboratory Manual in Food Microbiology*. Food Science Institute, Kansas State University.

United Nations, U. (2021). *World Food Safety Day*. United Nations; United Nations. https://www.un.org/en/observances/food-safety-day

United States Government Accountability Office. (2005). *Food Safety Experiences of Seven Countries in Consolidating Their Food Safety System*. United States Government Accountability Office. https://www.gao.gov/new.items/d05212.pdf

World Organization for Animal Health (OIE). (2019). *The OIE Terrestrial Animal Health Code* (Vol. 1). https://www.oie.int/en/standard-setting/terrestrial-code/access-online/

World Trade Organization. (n.d.). *WTO | Sanitary and Phytosanitary Measures—Text of the agreement*. World Trade Organization. Retrieved November 23, 2020, from https://www.wto.org/english/tratop_e/sps_e/spsagr_e.htm

World Trade Organization. (2014). *The WTO In Brief*. https://k-state.instructure.com/courses/99106/files/14063289?module_item_id=2303586

Kastner, Justin J., and Rosa K. Pawsey. Harmonising Sanitary Measures and Resolving Trade Disputes through the WTO-SPS Framework. Part II: A Case Study of the US-Australia Determination of Equivalence in Meat Inspection. *Food Control* 13, no. 1 (January 2002): 57-60.

Saensukjaroenphon, Kanyarat. "Personal Communication regarding livestock exportation in Thailand." Bureau of Livestock Standards and Certification: Department of Livestock Development, 6 January 2021.

Antarasena, Thiti. "Personal Communication regarding Poultry Compartment in Thailand." Bureau of Livestock Standards and Certification: Department of Livestock Development, 25 January 2021.

Appendix

General Requirements for Obtaining a KDA Grant of Inspection

1. Management must submit blueprints (3 copies) showing all rooms, equipment, water and sewage lines, drains, etc., and also submit a plot plan and specification list.
2. An application for grant of inspection and payment of the appropriate fee must be submitted. (Reg. 304.1)
3. The plant needs to arrange for office space for inspection personnel including desk, chair, and file with a hasp to accommodate the inspection division padlock. The office must be adequately lighted, heated, and cooled. In the case of a slaughter plant, restroom and shower facilities must be available. (Reg. 307.1)
4. The plant needs water and sewer certificates approved by proper authority and issued to the present plant owner.
5. The plant needs an approved employee supervision and training program detailing proper dress, personal hygiene (hand washing, use of hair nets and head coverings, etc.), and proper product handling procedures and techniques, including handling and separation of cooked and uncooked product.
6. The plant needs an approved sanitation program that designates a responsible person in charge, and a list of approved cleaning and sanitizing compounds showing when, where, and how they are to be used. (Plant management must write up and submit to the Inspector-In-Charge an acceptable cleaning procedure for floors, walls, ceiling, and equipment. This is to be placed in the inspection file.)
7. Plant management must establish fixed hours of operation during which inspected meat processing will be conducted. This period must be during normal working hours (a shift will be any continuous eight hour period Monday through Friday between 6am and 6pm) and prior to uninspected operations (unless a complete cleanup occurs after uninspected operations). Any hours outside of normal working hours must be approved by the Area Veterinarian Supervisor. If other than normal hours are utilized for inspected processing and/or inspected slaughter, then the plant will be billed overtime charges. (Reg. 307.4) (K.A.R. 4-16-7a)

8. All equipment must be easily cleaned, rust resistant, USDA approved (listed in current MPI-2), or approved by the Meat Program Administrator. Grandfathered equipment loses exemption upon change of ownership.
9. An approved pest control program is required.
10. The plant needs approved labels for all products produced in the plant, and a formulation and ingredient list for each product.
11. Letters of guaranty must be obtained by plant management for products such as wrapping paper, netting, seasonings, cure mixes, etc., and for any cleaning compound not listed in the chemicals compound book.
12. Only approved cleaning compounds will be allowed for use in the plant.
13. A designated Returned/Retained area is required.
14. Dry storage supplies must be up on racks at least 12" off floor. Food and food contact products (seasonings, spices, wrapping paper) must be stored separate from non-food products such as paint, paint remover, smokehouse cleaners, clorox, etc.
15. Restrooms must have self-closing doors, an exhaust fan that is wired to the light switch, and they must not open directly into the food processing area.
16. Any additional records and/or programs may be required as deemed necessary by inspection personnel that are pertinent for any unusual or new operational procedure or product produced by the plant.

The above requirements are in addition to the specific items identified on the official establishment review.