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An evaluation of hygienic practices in the small scale broiler supply chain in Amman Province

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DEDICATION

I dedicate this work to my entire family especially my father, kind hearted mother, brothers and sisters

To my wife, Rolla Hamed for her encouragement and patience during my absence,
I love you and our four daughters.

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ABBREVIATIONS:

DOS	Department of Statistic
DLS	Department of Land and Survey
EPIG	European Poultry meat Industry Guide
EU	The European Union
FAO	Food and Agriculture Organization
GDP	Gross Domestic Production
GHPs	Good Hygienic Practices
GMPs	Good Manufacturing Practices
HACCP	Hazards Analysis Critical Control Point
JCC	Jordan Credit Corporation
JD	Jordan Dinar (currency)
JFDA	Jordan Food & Drugs Administration
JISM	Jordan Standards and Metrology Organization
JISM	Jordan Institution for Standards and Metrology
MoA	Ministry of Agriculture
MoH	Ministry of Health
MoPIC	Ministry of Planning and International Cooperation
WHO	World Health Organization

SUMMARY

This research was conducted to evaluate the hygienic practices on small scale commercial broiler chain in Amman province to improve the broiler meat safety.

The definition of food safety according to Codex Alimentarius is: assurance that food will not cause harm to the consumer when it is prepared or eaten according to its purpose use (Codex, 2003). The governments all over the World are increasing their effort to improve food safety as a response to an increasing number of food safety problems.

Data for this research was collected by desk research, observations, survey and interview with different actors in the chain. The respondents were 40 broiler farmers, 4 broiler traders and 10 Natafat in the both districts (Aljiza and Wadi As Sayer). Moreover, the interview included the officer of Poultry Division in Ministry of Agriculture and the member of food safety committee in Amman Municipality. The collected data was analysed by using SPSS, crosstabs, graphs and Risk Assessment tool to come up with a clear picture about the hygienic practices implemented in Amman province.

The study revealed that there was no difference between the two districts in the implementation of hygienic practices in the farm, transport (trader) and Natafat. On the other hand, some practices were not complying with GHPs of EPIG or FAO which mean that these practices can contribute in food safety risks. Thus, threatening the consumers' health. Microbial hazards: such as *E coli*, *Salmonella* and *Campylobacter* and chemical hazards such as drug residues and Mycotoxins.

The study also discovered some practices which were in line with GHPs of EPIG and FAO such as: implement of vaccination program, prohibition of visitors by most farmers and a proper bleeding time by Natafat workers. These practices can contribute in the improvement of broiler meat safety issues.

The conclusion determines that: good hygienic practices are far below the standard required to reduce the food safety risks. So the study suggested some recommendations which are needed to help the chain actors, government and relevant authorities. These recommendations can contribute in the improvement of broiler meat safety and reduce the foodborne disease prevalence.

CHAPTER 1: INTRODUCTION

1.1 Broiler subsector background

Jordan is a relatively small country, with a population about 6.2 million in the year of 2010 (DLS, 2010). About 30% of Jordan's population is rural; less than 6% of those rural population (it is 6% of the 30%) is nomadic or semi-nomadic (Hashemite Kingdom of Jordan, 2011). Jordan's total area is 89287 sq. km and about 90% of this area is considered as semi-arid as a desert and 10 % arable land (MoA, 2011).

In 2011 the contribution of agricultural sector was about (2.7%) of the gross domestic production (GDP). The share of the animal production sector forms about (820) million Jordanian Dinar (JD[1]) or about (55%) of the total agricultural product. Poultry sector took the lead in animal production, in both investment and productivity, the investments is estimated to be 435 million JD which forms more than 51 % of livestock product, also providing more than 30000 permanent job opportunities. In 2011, this sector provided the local market with (87%) of broiler meat demands. The average consumption of broiler meat was 31.5 kg per capita in 2011 (MoA, 2011).

In 2010, the total reared birds were 28 million birds per production cycle with 20% coming from 5 big farms which can be called integrated companies, and the rest is derived from medium and small scale farms.

The broiler production increased from 134.2 thousand ton in 2000 to 177.9 thousand ton in 2010. In the same period, the number of broiler farms decreased whereas the capacity of farms increased which means the number of large scale farms increased as described in table 1.

Table 1 the total broiler meat production, imported meat, no of farms and capacity in period (2000 - 2010) in Jordan.

Year	Production 1000 ton	Capacity M/cycle	Import 1000 ton	No. of farms
2000	134.2	23.8	-	2074
2001	145.2	24.2	-	2140
2002	175.2	29.2	1	2213
2003	175.0	29.1	3.5	2206
2004	140.6	26.0	5.5	2164
2005	148.6	27.5	17.5	2202
2006	144.8	26.7	4.3	2039
2007	139.5	26.3	17.8	1940
2008	136.3	22.0	25.7	1887
2009	144.0	27.2	28.7	1866
2010	177.9	28.1	24.2	1909

Source: MOA, 2010

[1] Jordanian Dinar (1JD = 1.10 €uros) Sept. 9, 2012

1.2 Problem Statement

There is a knowledge gap about the safety of broiler meat along the small-scale commercial broiler chain which is exposing the broiler meat to a greater risk of contamination.

1.3 Justification

Since 10 years ago, the broiler subsector in Jordan has been growing fast becoming the leading livestock sector. This is due to the availability of inputs suppliers, low initial capital need and high demand. Therefore, the number of slaughterhouses[2] and small processing units (Natafat) are increased to meet the high demand on broiler meat. The amount of broiler birds slaughtered through the big slaughterhouses is about 55% of total production, whereas the other 45% of broiler production was done through small processing units (MoA, 2011).

The slaughterhouses use modern techniques and equipment in processing and packaging broiler meat and some of them have HACCP system (JISM, 2009). On the other hand, there is no information due to inadequate of researches about meat safety for Natafat which is selling live birds to consumers.

The food safety issues in the world has developed as one of growing importance due to a series of highly publicized food crises such as highly Pathogenic Avian Influenza, *Salmonella* and dioxin in Belgium. These have increased public awareness for food safety issues in the World. Moreover, this issue is becoming more important among people in Jordan as many people have complained on Natafat's improper way of broiler waste management and cleanliness of slaughter place (Allshawabkeh, 2010).

Due to the influence of the farm activities on the food safety issue in slaughtering process, the assessment of food safety risk should start at the farm level. According to (Bolder, 2007) the primary food safety target should be the freeing of pathogen in live birds. Thereby allowing slaughter plants to keep the processing line free of those microorganisms.

1.4 Objective

To evaluate the existing hygienic practices along the small scale commercial broiler chain in order to improve food safety in Amman province.

1.5 Main research questions and sub questions:

1. **Main question (1)**

What are the food safety requirements of meat along the broiler supply chain?

1.1 What are the hygienic practices required along broiler chain?
1.2 Which improvements can be implemented among the small scale broiler chain?

[2] Regulation Number 16: Licensing of poultry slaughterhouses
"This regulation states the specifications of poultry slaughterhouses and the minimum capacity level to be licensed which is 1000 bird / hour. It also points that the veterinary services must be provided through a veterinarian employed by the slaughterhouses. The MoA has the right of general veterinary supervision." (Ibrahem Abu-Iteleh, 2005).

2. **Main question (2)**

What hygienic practices are existing along the small scale broiler supply chain in Amman province?

2.1 Who are the actors in the small scale broiler production in Amman province?
2.2 What hygienic measures are implemented by the small scale broiler production in Aljiza and Wadi As Sayer districts?
2.3 What hygienic measures are implemented by the traders in Aljiza and Wadi As Sayer districts?
2.4 What hygienic measures are implemented by the small slaughter houses units (Natafat) in Aljiza and Wadi As Sayer districts?

1.6 Definitions of concepts

Value Chain Concept

A value chain is 'the full range of activities required to bring a product or service from conception through the intermediate phases of production to deliverance to consumers and final disposal after use' (Kaplinsky, 2000).

Small scale commercial broiler farmer

The producer of small broiler farm is within a range from 5,000 - 15,000 birds in one cycle. The government does not give a license for establishing a new broiler farm with a capacity less than 5,000 birds.

Trader or the middleman

This actor is very common in Jordan especially near the small scale farmers who do not have the slaughterhouses and transportation facilities. These traders are working in the purchase of live broiler chicken and selling them to small processing units (Natafat). These Natafat sell the live birds to consumers and the weight defines the price.

Natafat:

Natafat are small processing units which use simple equipment in slaughtering, cleaning and cutting the birds. Consumers come to these units, choose the birds according to weight and after that the worker will slaughter birds, clean and cut and give them to the consumer in plastic bag.

CHAPTER 2: FOOD SAFETY AND HYGIENIC PRACTICES

2.1 Introduction of food safety

The definition of food safety according to the Codex Alimentarius is assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use (Codex, 2003). In food safety the hazards refer to the contaminant that can cause illness or injury. Hazards can be classified into three main groups; biological (bacteria, viruses, parasites and fungi), chemical (pesticide, antibiotic, food additives, toxic metal and cleaning chemical) and physical (foreign metal such as hair, broken glasses and metal pieces). Food safety is growing important public health matter so the governments over the world are increasing their efforts to improve food safety. These efforts are as a result to an increasing number of food safety problems and rising consumer worries (WHO, 2007). The major foodborne diseases from microorganisms are Salmonellosis and Campylobacteriosis. In general foodborne diseases dramatically decrease if food is handled in proper way from purchase until the time it is served.

2.2 Importance of food safety

As an old proverb states “We are what we eat”, that means our health, physical, mental stability depend on the food that we eat and how we eat it.

According to the Centres for Disease Control and Prevention (CDC) in 2000, foodborne disease caused about 76 million illnesses; 325,000 hospitalizations and 5,000 deaths in the U.S. Results of the 2009 International Food Information Council Foundation Food & Health Survey indicate that more than half of Americans perceive foodborne illness from bacteria as the most important food safety issue today (Food insight, 2009).

Food systems in developing countries are not always as well organized and developed as in the developed countries. Furthermore, high growth population, lack of resources to deal with pre- and post-harvest losses in food, environmental problems and food hygiene mean that food safety in developing countries continue to be stressed, adversely affecting quality and safety of food supplies. Therefore people in developing countries are exposed to a wide range of potential food safety risks (FAO, n. d.).

In 2010, Jordan had 130,100 cases of diarrhea, 1,169 bloody diarrhea (severe diarrhea) and 364 cases of food poisoning which caused by unsafe food (Health, 2010). According to the WHO, yearly unsafe food contributes to 1.5 billion cases of diarrhea in children, resulting in more than three million premature deaths (Caroline, 2005). Also according to studies from WHO and FAO there are many Eastern Mediterranean countries including Jordan have not established surveillance or adequate reporting to identify and track foodborne diseases, so many cases are not reported (Caroline, 2005).

2.3 Food safety in broiler chain

The World production of broiler meat has been increased since the 1960s faster than any other types of meat. Also this growth has occurred in developing countries. In 2007, the total meat production is about 269 million tons over the World, whereas the poultry meat production is 88 million tons with 33% of global meat production. Chicken is the most common source of poultry meat in the World with 86 % (FAO, 2010).

As a result of food series of *Salmonella*, HPAI and dioxin in 2006 occurred around the World, the awareness for food safety has increased. As a result more food safety rules at national and European level were established such as the General Food Law (GFL) which is supported by the Dutch Ministry of Agriculture (Verreth, 2009).

According to the research conducted in Ireland in 2004 on consumers concerns in relation to how the food were produced, packaged, sold in shop and handled in consumer houses. Among several food stuffs such as chicken, fish, beef, pork, turkey, eggs, lamb, vegetables and fruit. From all of them the chicken has been indicated as more important for the consumer concerns (SafeFood, 2005).

2.4 Food safety principles in poultry sector

Most food producers and processors depend on food safety programs to protect the safety of the products. These programs based on mandatory and voluntary standards. Mandatory Standards such as Sanitary and Phyto-sanitary Standards (SPS) which is formulated by Codex Alimentarius and adopted by the governments. Voluntary standards such as Hazards Analysis Critical Control points (HACCP).

The HACCP system was developed for National Aeronautics and Space Administration (NASA) by the Pillsbury Company in order to provide safe food for astronauts.

According to the FAO the definition of HACCP is “a system which identifies, evaluates, and controls hazards which are significant for food safety“ (FAO, 2001). It’s aimed to prevent or reduce the known hazards that can occur at a certain stage in the food chain. Everyone involved in the food chain; farmer, collectors, transporter, processor, food handlers and consumers have a responsibility to assure that food is safe for consumption.

In general there are seven principles important to implement the HACCP in any food product;

1. list of food hazards
2. Determine the critical control points (CCPs).
3. Establish critical limits (CL).
4. Establish a system to monitor of each CCP.
5. Establish the corrective action to be adopted when monitoring indicates that a specific CCP is not under control.
6. Establish procedures for verification to prove that the HACCP system is working effectively.
7. Establish documentation and records regarding all procedures.

2.5 The potential risk factors

Food chain from farm to fork has been exposed to many food safety risks such as microbiological, chemical and physical. Also these types of risks can be recognized as potential risk of foodborne factors (Kiilholma, 2007). The last group of risks comprises physical hazards, will not be considered in this report. Physical factors refer to foreign materials which normally do not happen in broiler meat as a result cause risk for consumers.

2.5.1 Microbiological factors

The biological contamination can be done by one of these groups, Bacteria, Virus, Mycotoxins, Prions and Protozoa. The most important group of these risks in relation to the poultry is bacteria such as *Salmonella spp*., *Campylobacter spp., Clostridia, Listeria, Enterococci* and *E. coli* (Kiilholma, 2007). *Salmonella* and *Campylobacter* are most common pathogens cause foodborne diseases. They can be transmitted vertically from hen to egg or horizontally by contamination with environment.

Bacteria

Salmonella is most foodborne pathogens worldwide and represents the leading cause responsible for infectious gastroenteritis in the world. *Salmonella* bacteria were first identified in 1885 by American scientists Smith and Salmon (FDA, 2011).

Salmonella is easy to spread from farm to processing and later to consumers especially by non-processing products. The risk of transmission of bacteria from breeders to the farm through the hatcheries is small especially if the hatcheries implement Good Hygienic Practices (GHPs). The other transmission ways for contamination of *salmonella* and *campylobacter* can be by contact with wild birds and rodents, poor hygienic practices from visitors and workers, dead birds and poor waste management. Study conducted in Algeria on the occurrence of *Salmonella* contamination on 30 broiler farms and 15 broiler slaughterhouses. It found that *Salmonella* contamination concerned 37% of the broiler farms and 53% of the slaughterhouses. The study identified ten different serotypes. The most frequently recovered serotypes in both broiler farms and slaughterhouses were S. *hadar* (36%), S. *virchow* (16%) (Elgroud *el at*., 2008). In study was conducted in broiler flocks in Egypt found that the most frequency of *Salmonella* serovars were S. *enteritidis* and S. *typhimurium* (Wafaa *el at*., 2012). Also another research was conducted in Egypt found the prevalence of *Salmonella* was 14% in broiler chicken, 4 % in raw frozen chicken meat and 10% patients with food poisoning signs (Nagwa S. *et al*., 2012) see table 2. However, to prevent *salmonella* contamination effect should be cooked food properly and use a range of sanitary practices.

Table 2: The prevalence of *Salmonella* isolated from chicken, chicken meat and human

	Samples	No	Samples %
Broiler chickens	50	7	14
Raw frozen chickens meat	50	2	4
Patients with poisoning signs	30	3	10
Total	130	12	9.23

Source: Nagwa S. *et al*., 2012

Campylobacteriosis disease is caused by *Campylobacter* bacteria. The most common species of *Campylobacter* have been associated in human diseases are: C*. jejuni* and C. *coli* which are responsible for most of gastrointestinal-related infections. *Campylobacter jejuni* is particularly adapted to poultry. The common way of transmission is by fecal to oral, eating contaminated food and raw meat. The bacteria can be transmitted vertically from infected human to the broiler either in the farm or during the slaughtering process. According to a study conducted on 140 broiler flocks slaughtered in Amman slaughterhouse in Jordan. The result found that 40% of the flocks tested by cloacal swabs, 34% at prescalding, 32% at post 57 C° scalding, and 32% post-evisceration were containing *Campylobacter jejuni* (Osaili, Alaboudi, and Al-Akhras, 2012) see table 3.

Table 3: Prevalence of *Campylobacter jejuni* in Tested flocks before and during Processing

Sampling point	Number of tested flocks	Number of flocks positive (%) for *Campylobacter jejuni*
Cloacal swabs	140	56 (40)
Feathered skin, prescalding	140	48 (34)
Skin after scalding at 62 C°	115	0 (0)
Skin after scalding at 57 C°	25	8 (32)
Skin after evisceration (Scalding at 62 C°)	115	14 (12)
Skin after evisceration (Scalding at 57 C°)	25	8 (32)
Skin after washing-chilling	140	0 (0)
Total number of isolates		134

Source: Osaili, Alaboudi , and Al-Akhras, 2012.

The contamination site of *Campylobacter* starts from the farm where the *Campylobacter* exists. Then the sources of contamination on broiler carcasses can happen through feces and feathers at scalding, evisceration or by water chilling. And *Campylobacter* can still exist in the product to the retailing level (Stern and Robach, 2003). Therefore, the proper evisceration and repaid chilling are recommended to prevent further contamination and stop growth of *Campylobacter* and even *Salmonella*.

Other microbiological risk factors

These factors include viruses, Mycotoxins, Helminths, Prions and Protozoa. Also some types of bacteria such as *Listeria*, *Clostridia*, *Enterococci* and *E. coli* which cause foodborne diseases through broiler meat contamination but can be less than *Salmonella* and *Campylobacter* impact.

Virus is important hazard factor especially Highly Pathogenic Avian Influenza (HPAI) which can be very dangerous for human health as well as for poultry sector production. This virus doesn't have direct hazard influence on the consumer of the processed broiler products.

Mycotoxins are a secondary metabolic product for a certain strains of fungus and can be found in different poultry feed ingredients. Mycotoxins can be produced in plants in different stages of plant life: during growth, harvesting, processing and storage. Mycotoxins are affecting about 25% of the world's crop every year. Most of these mycotoxins come from three types of fungi: Aspergillus, Penicillium and Fusarium. While over 300 types of Mycotoxins are known, those types are most popular according to high toxicity and occurrence: Aflatoxin, Vomitoxin, Ochratoxin, Zearaleone, Fumonisin and T-2 toxin. (Akande K. E, 2006). Broiler considers less sensitive to Mycotoxins than pigs and more sensitive than ruminant, toxicosis by mycotoxins is characterized by a reduce appetite, lesions of the intestinal tract and immunosuppression (Smith, 2006).

2.5.2 Chemical factors

Chemical risk factors can be introduced in farm even during the slaughtering stage, by adding preservatives materials (Antimicrobial Agents), or by the detergents and

disinfectants which are used in cleaning and disinfection of equipment. However, most of chemical substances in broiler meat are residues of medicine, pesticides and heavy metals. Chicken feed factories can be a source of chemical contamination by adding chemotherapeutical to the feed to kill or stop growth some types of microbes. Coccidiostat is widely used in feed factories to reduce the influence of Coccidiosis in the farm. These chemical residues in broiler meat and products can cause some diseases for the consumers such as cancer, immune deficiency and nerve damage.

Antibiotic is common used by the broiler farmers to decrease the effect of diseases, increase growth rate, enhance feed conversion and decrease the mortality rate. Increasingly, the use of antibiotics in broiler production leads to increase antibiotic-resistant infections in humans. This leads to increase risks of human diseases by these pathogens such as *Salmonella*, *Campylobacter* and other resistant microbes. In 1999, five antimicrobials (Avoparcin, Virginiamycin, Bacitracin zinc, Tylosin phosphate and Spiromycin) which commonly used as antimicrobial growth promoters (AGPs) in food-producing animals were banned by the EU (Hughes, 2007).

The pesticides residue can reach the human body by indirect way by eating food and meat containing these chemicals and direct way through exposure to the pesticides in farm. Pesticides are used in crop protection from insects, fungus, bacteria and virus. Also can be used on animal farms to control insect pests. The intensive use of pesticides in many developing countries has affected the food safety through animal feed with a high level of residues (Kiilholma, 2007).

From January to June 2001, 27 percent of food exports from Egypt, Jordan, Lebanon, and Syria to the United States were rejected by the U.S. Food and Drug Administration. This rejection was due to non-compliance with the U.S. safety measures (microbiological contamination, greater than permitted levels of pesticide residues or food additives) (Smith, 2005).

On the other hand, some decontamination substances such as chlorine dioxide, lactic acid, acidified sodium chlorite, trisodium phosphate and peroxyacids, which are used in slaughterhouses to reduce the population of microbes on broiler carcasses are prohibited in EU (EFSA, 2011). But in other countries it is not regulated yet.

2.6 Good Hygiene Practices in broiler chain

According to FAO the meat safety is the control throughout the food chain from farm, and inspection before and after slaughter to the processing, handling and storage of meat until the time of consumption. The responsibility for safety of meat production is shared by industry and the controlling authority (FAO, 1992). Also the food hygiene includes the all conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain (Codex Alimentarius, 1997).

The Codex Alimentarius Commission has elaborated the Recommended International Code of Hygiene Practices for Fresh Meat (CAC/RCP 111976) and the Recommended International Code of Hygienic Practice for Poultry Processing (CAC/RCP 14-1976). These Codes explain the minimum requirements of hygiene for meat and poultry production (FAO, 1992).

In the next sections the GHPs mostly depend on the EPIG and FAO instructions for the prevention and control of Microbiological infections of meat production in farm, transportation and slaughterhouses.

2.6.1 Good Hygienic Practices at broiler farm level

The maintenance of health and good hygiene throughout the whole production system is important to produce a healthy chicken. Disease is a main hazard in broiler rearing, especially with the growth in large numbers and in intensive production. Hygiene is a main factor in disease prevention. Efficient cleaning can eliminate over 90% of all diseases (FAO, 1992).

GHPs are the best management practices on broiler farms decreasing the possibility of introducing zoonotic diseases such as *Salmonella* and *Campylobacter* also infectious diseases especially Avian Influenza and Newcastle diseases. Broiler farmers should understand the importance of, and be aware with, the specifics of GHPs and work strictly to implement those practices in order to keep a constant high hygienic level.

Based on (EPIG) for GHPs in broiler farm, there are some measures taken to ensure a good hygiene and to prevent diseases at the farm (EPIG, 2010):
Farm Location: should be located away from other livestock farms. The buildings: should be built of durable material that can easily and effectively be cleaned and disinfected. Poultry houses and all equipment should be cleaned with a high pressure water cleaner, detergents and disinfectants. Management, staff and visitors should follow the personal hygienic practices and committed to bio-security rules. Birds of the same should be reared in each house, all in all out. For bio-security procedures; Clothing, footwear, cleaning facilities & materials should be provided and laundered for all staff and visitors and a foot-bath should be installed containing disinfectant. Monitoring sampling and testing for *Salmonella* status in the flock.

2.6.2 Good Hygienic Practices at trader / transport

In this case the trader is who transport the birds from the farm to small processing units (Natafat). The transportation is an important factor should be organized to prevent disease transmission and keep birds healthy.

Instructions for hygienic catching, loading, unloading and transport of live birds (EPIG, 2010):

1- The role of bio-security during catching, loading and unloading is essential. Therefore these activities should be made to guarantee that no cross-contamination will happen.
2- The firm of birds transportation should be properly registered and be fully responsible for the proper disinfection of the means of transport.
3- Nominate a member of the catching team responsible for the catching, loading and unloading operations.
4- The poultry should be transported by authorized transporters in vehicles and crates that have been well cleaned and disinfected after unloading and before leaving the slaughterhouse with effective disinfectant for *Salmonella*.
5- Poultry transport to slaughterhouse must be done in a direct way without pass through poultry sites.

6- Vehicle drivers and catching and loading team should be trained and informed in proper way that they understand the personal hygiene and are aware by which disease can be spread by hand, equipment and clothes.
7- The transporter should communicate with the farmer for the time of transportation and scheduled slaughter, thus that the farmer can implement a proper feed withdrawal program to comply with slaughterhouse instructions.

Also according to FAO principles for transportation of live birds there are some measures (FAO, 1992):
Poultry should be taken off their feed and water one to four hours before they are loaded and taken for slaughter house, depending on distance from the slaughterhouse. Feed withdrawal is necessary to decrease the chances of contamination by feces during transportation and in slaughterhouse. Birds should be picked up gently by hand to avoid bruising of the flesh and breakage of bones. It is necessary that the birds are not overcrowded and liable to overheat. The empty crates should be washed after use and if crates are not used for long time then the process should be repeated. The vehicle also should be cleaned and disinfected after use.

2.6.3 Good Hygienic Practices at broiler slaughter houses

In broiler slaughterhouse the ante- and post-mortem health inspection of birds is very important. This is usually carried out by a qualified veterinarian or meat inspector. In Jordan the qualified staff in public slaughterhouses is appointed by the Ministry of Agriculture, but in private slaughterhouses the staff is appointed by the owners. Ministries of Agriculture and Health have the authority to supervise and control the work of the slaughterhouses.

According to (EPIG), the GHPs in broiler slaughterhouse can be taken to ensure a good hygiene and to prevent contamination (EPIG, 2008) are:

The live birds should be handled quietly, slaughtered using properly designed. Equipment maintained and cleaned in a properly managed place of the slaughterhouse. The most important areas to monitor are the reception area for the live birds, the de-feathering machine, the scalding tank area and the chilling tank. Scalding water should be clean as possible. Slaughterhouses management should be organized in the determined control points and monitoring according the HACCP principles. According to the (EPIG) the slaughterhouse should implement all hygienic practices to avoid cross contamination between flocks during the slaughter (EPIG, 2008).

2.7 Broiler waste management

The production of poultry results in farm; manure (birds' excretion), litter (litter such as sawdust, wood shaving and straw) and dead birds. The poultry slaughterhouses results are offal (feathers, blood, evisceration waste and organs of slaughtered birds). The poultry wastes give rise to potential environment and human concerns as they can be a source for chemical contamination, pathogenic microbes, vectors for insects and vermin. These wastes pollutants centre on water, air and soil. Groundwater contamination is from manure potential pollutants such as nitrogen, phosphorus and potassium. Air quality is affected by ammonia, hydrogen sulphide and dust particulates produced from poultry houses and manure. Greenhouse gas emissions and human health can affect with nuisance odorants (Charlesl, n.d). Soil contamination happens by a certain metals

such as copper and zinc which may be contained in manure and these metals can be toxic for crops. Options for poultry waste management:

- Land application as a fertilizer for crops

Poultry manure has been used to improve the land productivity of plant crops for centuries. Environment fate is influenced by the methods of collecting, storing, handling, treating, transporting and applying the manure. For examples; the manure should be kept as dry as possible to prevent aerial emissions of gases and assist fly control. The manure should not be in contact with rainfall or rain runoff. Land application should be based on plant requirement, and analysis for nutrients contained in soil and manure. A proper management of composting can reduce pathogens, insect eggs and weed seed by the heat generated during the biological processing, also reduce bad odor emissions from manure storage and treatment area. As well as the slaughter waste can dispose and utilized by composting (Bharathy, N 2012).

- Animal feeding:

Scientific research has documented that nutrients in manure and litter can be safely recycled to be a component of livestock and poultry diets especially when the pathogenic microbes are managed (McCaskey, 1995 in Charlesl, n.d). However, this practice depends on regional regulations for using manure in animal feeding. The using of broiler slaughterhouses waste in animal feeding is becoming tighter (EU, 2000 in Salminen E., 2002). Some cautions are essential when manure is used as animal feed such as copper toxicity when poultry litter is fed to sheep, *Salmonella* and other pathogenic microbes can be found in improper processed manure. Also, antibiotics and Mycotoxins can be present in manure.

- Bioenergy production:

Poultry manure contains organic matter that can produce biogas under certain processing technologies. The biogas may be used at farm for heat or as fuel for engines that produce electricity. An additional advantage that manure can be used as fertilizer.

2.8 Jordan Legislation

Jordan Institution for Standards and Metrology (JISM) is the official body for the preparation and publication of Jordanian Standards in cooperating with related Ministry. Laws, regulations and instructions are issued in the following routes:

- All laws and regulations issued through Legislation and Opinion Bureau, depend on Jordanian Constitution, and with coordination of Council of Ministers.
- All instructions are issued through and by Council of Ministers or related Ministry. And they are enforced directly after their publishing in the official journal.

The food control regime falls under two laws: Agriculture Law No. 44 of 2002 and Jordanian Food Control Law 79/2001.

Agriculture Law (No. 44 of 2002) which is set based on Codex Alimentarius and control all agricultural products especially that imported by the private sector such as the Article 9A of Agricultural Law No. 44 of 2002 for importing chicken meat and chicken meat products.

Also Agricultural law contains the agricultural instructions such as the instruction no. (Z/4) of 2003 for licensing broiler farms which it include 15 articles. These articles

include some hygienic practices such as the distance between two farms should be more than 300 m and 600 m [3] if one of them is parent stock farm and the construction of chicken house should be suitable for broiler production and easy to clean and disinfect.

Food Law; 79/2001, It establishes the general principles governing food quality and safety at national level. And enforcement of the food law was under the umbrella of MoH until 2003. In 2003 the JFDA was in charging by **law of JFDA Act; 31/2003**.

The JFDA is a statutory, independent and science-based body, committed to protect public health and consumer interests in the area of food safety and hygiene. It comes under the umbrella of the Minister of Health (Jordan University, 2008).

It aims to prevent of:

1- Unsafe food handling
2- Fraudulent or deceptive practices
3- The adulteration of food
4- Any other practices which may mislead the consumer

Small processing units

According to the municipality's instruction which is issued by Ministry of Municipalities Affairs (No. 14/2007) for the livestock and poultry small slaughterhouses license:

Article 7 A1, Articles 8 A1, 2, 3, 4 are for organizing the hygienic conditions and worker medical health certificate in small slaughterhouses.

For livestock and poultry big slaughterhouses, MoA issued instruction No. (Z/16/2003). Those slaughterhouses have to meet all hygiene conditions and other instruction in Articles 1 to 14 such as they should appoint a veterinarian for ante- and post-mortem inspection.

On the other hand, Jordan has nine broiler slaughterhouses with a total capacity of 32.5 thousand birds / hour and they slaughter 55% of total broiler production (MoA, 2011). These slaughterhouses are distributed in several provinces in Jordan. The largest one is in Al Mafraq province and is owned by Al Jazera Company for poultry see table 4. Integrated companies have the slaughterhouses near to their farms so the transportation effect is limited.

[3] m = meter

Table 4: Broiler slaughterhouses in Jordan (2011)

No.	Slaughter house	Capacity bird/hour	Location
1	Al Jazera	8000	Al Mafraq
2	National Poultry Company Slaughter house	6000	Qatraneh / Al Karak
3	Al dlail	4000	Al dlail /Alzarqa
4	Altahounh	3000	Al tafeh / Alzarqa
5	Tamam slaughter	3000	Alzarqa
6	Amman Municipality slaughter	2500	Amman
7	Shediafat slaughter	1500	Almafraq
8	Jarash slaughter	3000	Jarash
9	As Salt	1500	As Salt
Total	9 slaughterhouses	32500	

Sources: MoA, 2011.

CHAPTER 3: METHODOLOGY

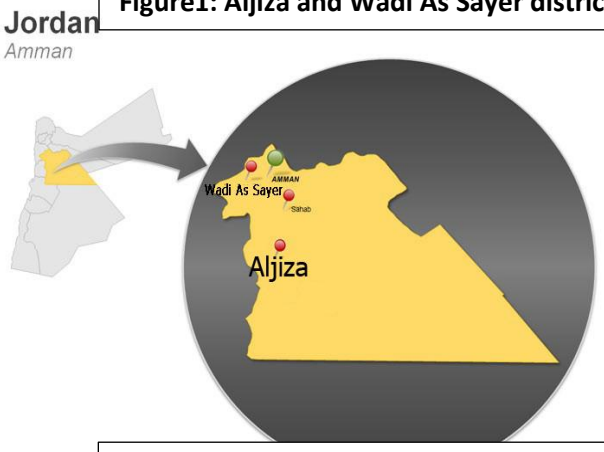
3.1 Study Area

The research was conducted in Amman province. It is the country's political, cultural and commercial center and the capital of Jordan. It has a population of 2.36 million inhabitants in 2010 (DoS, 2010). Amman is situated in a mountainous area of north-west of Jordan. The city's elevation is range from 740 to 1,400 m. It is administered as the Greater Amman Municipality and divided into 9 districts.

Amman with the biggest economic situation, high intensity population, availability of input suppliers and feed factories that lead to occupy the second place after Irbid province in broiler production (MoA, 2011). Most of broiler farmers are medium and small scale farmers. The total number of farms is 320 with capacity of production 4.9 million birds per year, which distributed into mean six areas in Amman as depicted in table 5.

Aljiza and Wadi As Sayer districts were chosen for the research as they are located in different geographical area in Amman (Figure 1). Aljiza is located in the south of Amman whereas Wadi As Sayer is located in northern part of Amman. Actually the southern part has more poverty and unemployment rate than the northern part. According to the MoPIC, Aljiza is one of 32 registered pockets of poverty in the country (MoPIC, 2011).

Figure1: Aljiza and Wadi As Sayer districts



Source: 24point0.com (13 May 2012)

Table 5: The broiler production, no. of farms and their capacity in Amman province (2011)

Province	No. of farm	Capacity 1000 birds	Production 1000 Ton of meat
Amman	37	589.7	5.26
Wadi As Sayer	43	534.09	4.76
Sahab	25	408	3.64
Aljiza	84	2000	17.85
Na'oor	49	678.48	6.05
Almoqar	82	752.95	6.72
Total	320	4963.2	44.28

Source: MOA, 2011

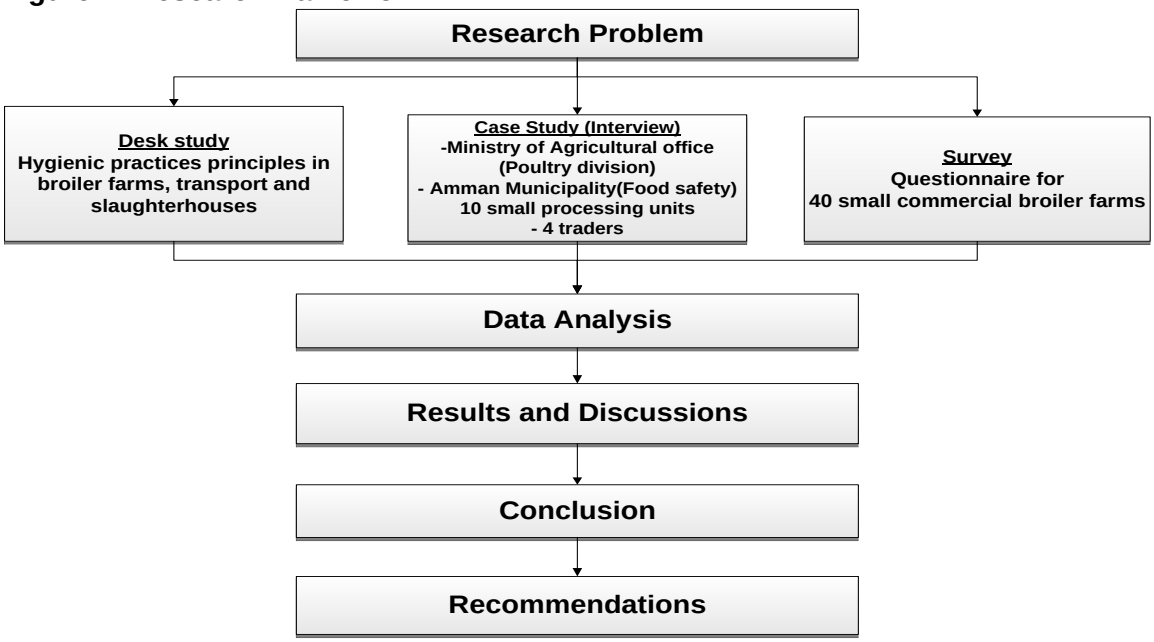
3.2 Research Methodology

The research has qualitative and quantitative data which was based on desk research, survey, case studies and observations. Desk research data was collected by internet search, through Library of Wageningen University also by ministries reports from Jordan. Primary data was collected by providing survey, questionnaires and my own observation in area study.

3.3 Research Framework

In order to have a deep insight of the situation of small commercial broiler chain a research framework was developed as depicted on figure 2.

Figure 2: Research framework



Desk research was based on internet, library of Wageningen University, information and reports from different sources in Jordan especially the Ministry of Agriculture. Internet websites and Wageningen University Library were used to inquire information about the hygienic practices in broiler farms and slaughterhouses. Field study was conducted by case studies and surveys on different actors in broiler supply chain which included 40 small commercial broiler farms (20 farms from Aljiza district and 20 farms from Wadi As Sayer district), 2 traders and 5 Natafat from each district.

More information was taken through an interview with the Ministry of Agriculture / Poultry Division officer and Amman Municipality / Department of Food Safety officer (Table 6). All of this information was analysed by using cross tabulation and SPSS to come up with a conclusion and recommendations for the Ministry of Agriculture and Municipality of Amman.

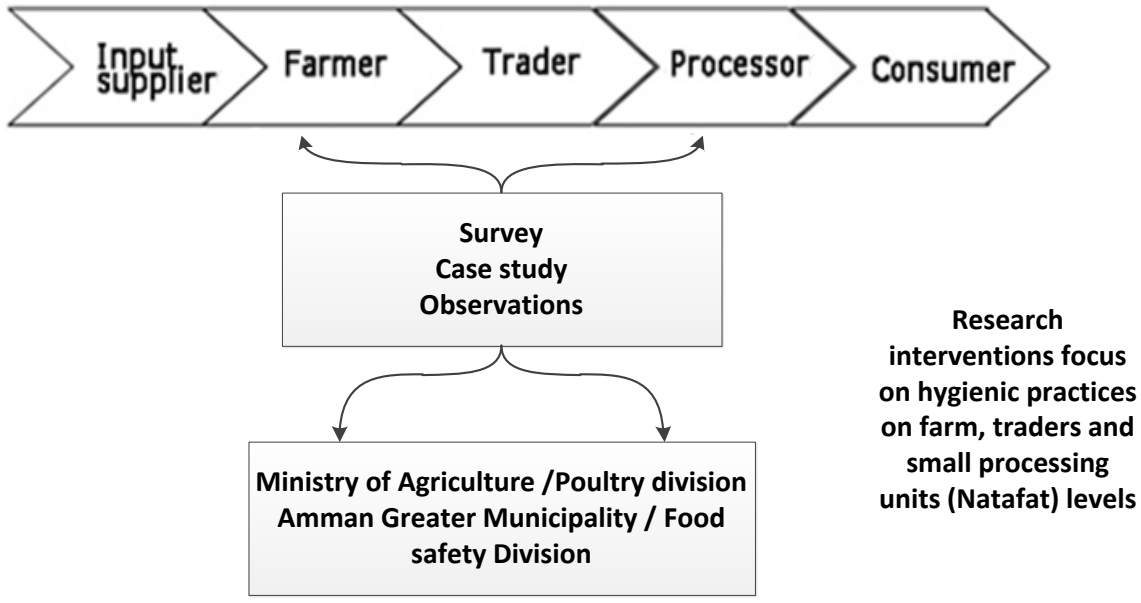
Table 6: Summary of data, data sources and tools

Sub-Question	Data	Data source	Tool of data collection
1.1	Hygienic practices standards	Desk research	Internet, Wageningen library
1.2	Food safety requirement	Field study	Case study and survey
2.1	Broiler chain structure	Field study, Districts officers	Case study and survey
2.2	Hygienic measures implement on farm	Broiler farmers	Survey
2.3	Hygienic measures implement by traders	Broiler traders	Case study
2.4	Hygienic measures implement on Natafat	Natafat slaughter man	Case study

3.4 Conceptual Framework:

The field study was conducted on the small commercial broiler supply chain in Aljiza and Wadi As Sayer districts. The actors were included in the case studies are farmers, traders and small processing units. Ministry of Agriculture officer/ Poultry Division and Amman Municipality / Food safety committee are considered as influencers, (Figure 3).

Figure 3: conceptual framework



3.5 Study Design

3.5.1 Desk research

Desk research was used to collect data from existing literature that's necessary to establish strong information for the research. The sources for desk research data are articles journals, text books, international and national reports such as Ministry of Agricultural reports, Ph.D. theses and internet websites.

3.5.2 Survey

A survey was used to collect primary data by structured questionnaires which were designed for small commercial broiler farmers. The livestock supervisors in Agricultural office of Aljiza and Wadi As Sayer districts assisted in data collection by using random sampling to choose 20 small commercial broiler farmers from each district. Interview of farmers was done individually to be sure the farmers' answers will not affect each other. The questionnaire focused on hygienic practices in broiler farms. The questionnaire is presented in Annex 1.0.

3.5.3 Case study

This method of data collection designed for interviewing of four broiler traders and ten Natafats in both districts. The Municipality of Amman and poultry division officers were interviewed by using semi-structured questionnaires. These interviews were conducted face to face by using prepared checklist. This was done in order to collect data about the practices regarding food safety issues about broiler production, transportation and processing at Natafat.

Broiler traders

The four broiler traders were interviewed in both districts. Traders are selling and transporting the broiler birds from farms to the Natafat. Traders agree with farmers to purchase the birds and at the same time they agree with Natafat to sell the birds. The interview concentrated on knowing what hygienic practices are followed by traders.

The officer of Ministry of Agricultural and Amman Municipality interviews

The interviews of governmental officers aimed to collect more data about the hygienic practices are implemented by small commercial broiler farmers and small processors. The hazards on food safety are common along small commercial broiler chain. The government rules on relation to the food safety applied along broiler supply chain.

3.5.4 Observations

This method of data collection depended on what observed during the data collection from broiler farmers, Natafat workers and during interview of broiler traders in relation to the hygienic practices implemented in the chain (Table 7).

Table 7: List of stakeholders interviewed and method of data collection

#	Stakeholder	Method of data collection	No. of persons
1	Broiler farmers	Survey	40
2	Traders	Case study	4
3	Natafat	Case study	10
4	Amman Municipality	Case study	1
5	Ministry of Agriculture officer	Case study	1
6	Total		56

3.5.5 Data Analysis

The data was collected through surveys, coded and analysed by using Statistical Package for Social Sciences version 19 (SPSS, 2010). The significant difference was considered when the value of $P < 0.05$. Interviews data described and explained in results chapter.

3.5.6 Tools for data analysis

The collected data was analysed by using SPSS, cross tabulation, excel sheet to draw some graphs and Risk Assessment tool.

Risk Assessment tool

The risk assessment or risk and hazards analysis tool was used to determine the potential hazards found in broiler farm and Natafat in the small scale commercial broiler chain in Amman Province. The risks were ranked into three levels: low, medium and high (more details in section 4.10, chapter 4).

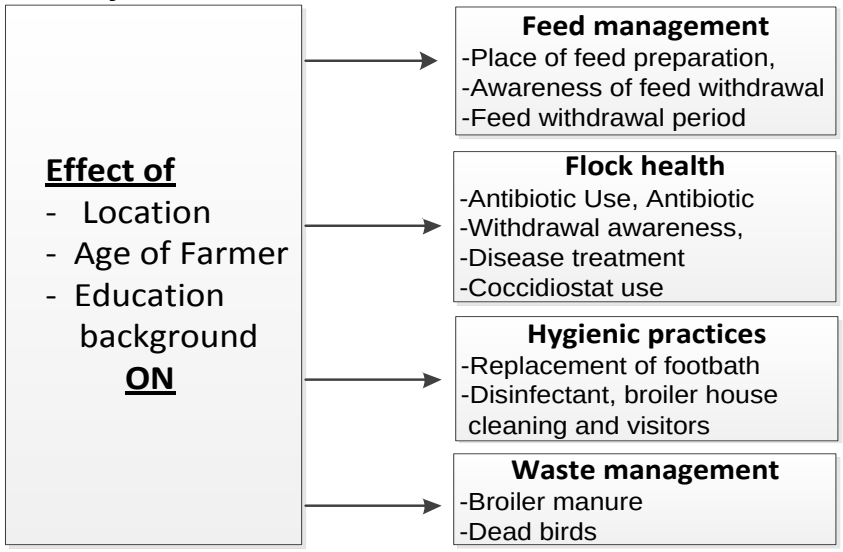
CHAPTER 4: RESULTS

4.1 Broiler Farms

4.1.1 Farm owner's Background

This section of results explains the farmers' background such as the age, educational background, farm capacity and number of production cycles per year (batches). The background information of small scale farmers is very important to tailor interventions to determine the circumstances of broiler producers. On the other hand, farmer's information was used as an indicator for assessing the behavior of farmers in relation to feed management, flock health, waste management and hygienic practices as shown in figure 4.

Figure 4: Data analysis framework



Farmer's age, educational background, farm capacity and number of production cycles per year

Table 8: Farmers age, farm capacity, production cycle and educational background of broiler farmers in Aljiza and Wadi As Sayer districts.

Item	Districts			
	Aljiza		Wadi As Sayer	P-Value
Farmer Age (year)	42.5 ± 1.65		49.3 ± 2.25[a]	P=0.021
Average farm capacity	12825 ± 633		10995 ± 677	P=0.056
Average production cycle / year (no. of batches)	5.2 ± 0.137		5.3 ± 0.163	P=0.643
Educational level	No.	%	No.	%
- Primary	2	10	3	15
- Secondary	10	50	11	55
- College	8	40	6	30
Total	20	100	20	100

[a] Mean ± S.E

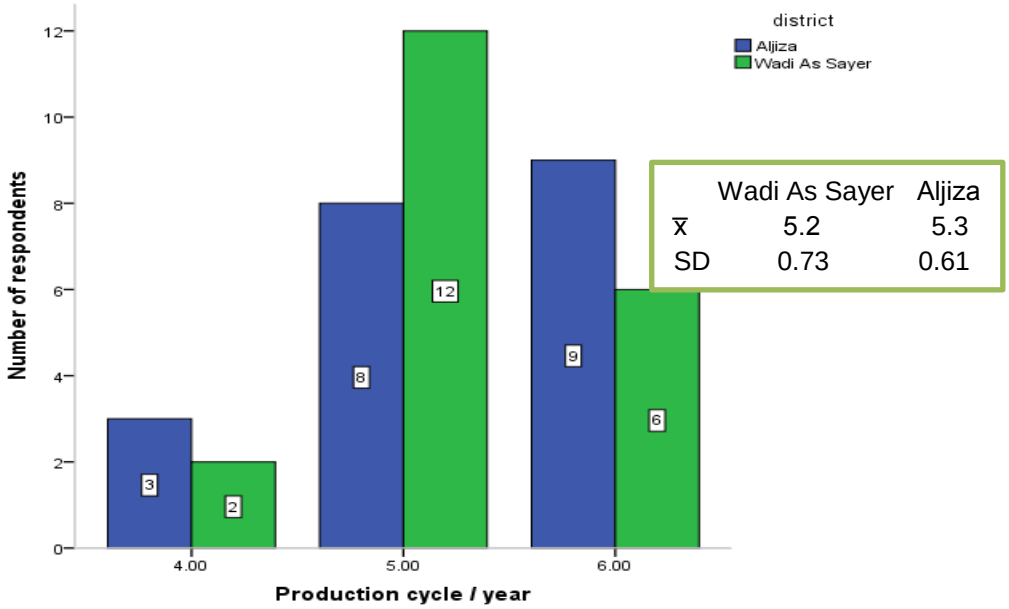
As shown in table 8, There was a significant difference in average age between the two districts at (P<0.05). The broiler farmers in Aljiza and Wadi As Sayer districts had an average age of 42.5 and 49.3 years, respectively. It was found that 70 % of the farmers in both districts are within the age range of 31–50.

Farmers in both districts have a high literacy level. 40% and 30% of farmers in Aljiza and Wadi As Sayer districts have the college educational background or above, respectively.

The average number of birds raised per production cycle by the broiler farmers in both districts showed that Aljiza district had a higher average number of birds per cycle as compared to Wadi As Sayer district (12825 vs. 10995, respectively).

It was found that there was no difference between the number of production cycles per year between the two districts (Figure 5)

Figure 5: Production cycles per year for the both districts



4.1.2 Feed management

This section explains the effect of location, farmer's age, and educational background on feed management (place of feed preparation, Awareness of feed withdrawal and feed withdrawal period) at farm level to determine what hygienic practices of broiler feeding were followed in both districts.

Effect of Location

As shown in table 9, only four farmers in Aljiza district prepared the feed in the farm as compared to nine farmers in Wadi As Sayer district. On the other hand, 80% and 55% of farmers bought ready feed in Aljiza and Wadi As Sayer, respectively. Also most farmers in both districts have awareness of feed withdrawal before selling the broiler to slaughterhouses. As shown in table 9, data reveled that there was no significant differences between the two districts for feed withdrawal period.

Table 9: Effect of location of broiler farms on feed management

Item	District			
	Aljiza		Wadi As Sayer	
	No.	%	No.	%
Feed production				
- On farm	4	20%	9	45%
- Feed mill	16	80%	11	55%
Feed withdrawal awareness				
- Yes	17	85%	16	80%
- No	3	15%	4	20%
Feed withdrawal period:				
- 1 hours	1	5.9 %	0	0%
- 2 hours	4	23.5%	1	6.2%
- 3 hours	8	47.1 %	10	62.5%
- 4 hours	3	17.6%	3	18.8%
- 5 hours	1	5.9%	2	12.5%
Total*	17	100%	16	100%

*The total number of farmers whom have awareness for feed withdrawal

Effect of Age

In the both districts, 45.5% of farmers within the age range of 41–50 years have awareness of feed withdrawal before selling the birds. Whereas the most of farmers withdrew the feed before 3 - 4 hours of selling birds to slaughterhouses, as described in table 10

Table 10: The effect of farmers' age on feed withdrawal awareness and withdrawal period

	The awareness for feed withdrawal before selling to trader				Feed withdrawal period (out of 33 farmers have awareness)			
Farmers age	Yes		No		1 – 2 hrs.	3 – 4 hrs.	> 5 hrs.	Total
20 – 30	1	3.0 %	1	14.8 %	-	-	1	1
31 – 40	9	27.3 %	1	14.8 %	2	6	1	9
41 – 50	15	45.5 %	3	42.8%	3	10	2	15
51 – 60	7	21.2 %	1	14.8 %	-	7	-	7
61 – 70	1	3.0 %	1	14.8 %	-	1	-	1
Total	33	100%	7	100 %				33
P-value	P= 0.497				P=0.515			

Effect of educational level

The effect of educational level on feed withdrawal awareness in both districts was significant (P<0.05) by using Mann-Whitney test. Out of 33 farmers who have awareness

13 farmers have a college background or above. Whereas most of farmers who did not have awareness for feed withdrawal are having primary educational backgrounds (Table 11).

Table 11: The Effect of educational level on feed withdrawal awareness

Item	Primary	Secondary	College and above	Total	P-Value
Feed withdrawal awareness					
- Yes	1	19	13	33	P=0.001
- No	4	2	1	7	

4.1.3 Flock health

This section of results explains the effect of location, farmer's age, and educational background on health management of broiler flock (antibiotic use, antibiotic withdrawal awareness, disease treatment and coccidiostat use) in both districts

Effect of location

There was no difference between the two districts in times of antibiotic administration, as shown in table 12, most farmers in both districts administered antibiotics three times per production cycle.

In Aljiza district there was a total of 16 farmers whom had an awareness of antibiotic withdrawal before selling the birds to slaughterhouses as compared to 15 farmers in Wadi As Sayer district. However, most farmers did not strictly adhere to the withdrawal period of antibiotic.

In case of diseased flock, most farmers surveyed in both districts were relied on their own experience to characterise diseases and administer the medicine. Table 12 showed that 13 and 17 farmers addressed the disease symptoms by themselves in Aljiza and Wadi As Sayer districts, respectively.

Results indicated that most farmers in both districts added coccidiostat to feed until slaughter time. Some farmers who bought feed from feed factories were not sure whether the coccidiostat was added to the feed or not. In general, most feed factories add coccidiostat to the feed unless the farmer asks for coccidiostat free diet. In Wadi As Sayer district there was three farmers did not add coccidiostat to the finisher feed as compared to one farmer in Aljiza district.

Table 12: Effect of location (districts) on flock health

Item	Districts			
	Aljiza		Wadi As Sayer	
Using of Antibiotic (per batches)				
- 2 times	1	5%	1	5%
- 3 times	12	60%	14	70%
- 4 times	7	35%	5	25%
Antibiotic Withdrawal Awareness				
- Yes	16	80%	15	75%
- No	4	20%	5	25%
Who treats sick birds				
- Farmer	13	65%	17	85%
- Veterinarian	7	35%	3	15%
Adding coccidiostat to feed during finishing period.				
- Yes	14	70%	15	75%
- No	1	5%	3	15%
- Don't know	5	25%	2	10%

Effect of farmers' age

Farmers' age range of 41 – 50 years old had the highest number of farmers who used three times of antibiotic during the broiler rearing. On the other hand, there were two farmers within the age range of 41 – 50 years in both districts used the lowest frequency of antibiotics. In general the times of antibiotic used depend on the health status of flock.

The farmers within the age range of 41 – 50 years had the highest frequency of antibiotic awareness. The oldest farmers (61 – 70 years old) in both districts did not have knowledge about the withdrawal period of antibiotic. Generally, majority of farmers did not adhere to antibiotic withdrawal period and they used antibiotics according to the health status of flock without any consideration for the withdrawal period.

Most farmers within age range of 41 – 50 years in both districts were using coccidiostat in finisher feed and addressed the disease symptoms by themselves (table 13).

Table 13: Effect of farmers' age on flock heath management

	20-30	31-40	41-50	51-60	61-70 years
Using of Antibiotic (per batches)					
- 2 times	-	-	2	-	-
- 3 times	1	4	13	6	2
- 4 times	1	6	3	2	-
Antibiotic Withdrawal Awareness					
- Yes	1	7	15	7	1
- No	1	3	3	1	1
Who address the disease symptoms					
- Farmer	2	7	14	5	2
- Veterinarian	-	3	4	3	-
Adding of coccidiostat to the feed (Finisher ration)					
- Yes	2	4	15	7	1
- No	-	1	1	1	1
- Don't know	-	5	2	-	-

Effect of educational background

Among the farmers' educational background, the secondary background has the highest number of farmers who used three times of antibiotic in broiler production. There were only two farmers with college background used antibiotics twice. The farmers mentioned that the antibiotics administration depend on the health status of birds flock.

Also 71% of farmers who have the secondary background level said yes for the awareness of antibiotic withdrawal period. Moreover, all of the farmers who have the college background had awareness of antibiotic withdrawal.

All the primary background's farmers addressed the disease symptoms in the farm and treated the birds by themselves compared with 78% of college background farmers that they consulted the veterinarian.

On other the hand, there was no difference in coccidiostat administration in finisher feed among educational background of farmers. Majority of farmers who did not use coccidiostat in finisher feed were prepared the feed in their farms. However, the coccidiostat administration in finisher feed depends on health of flock (table 14).

Table 14: Effect of farmers' education level on flock heath management

	Primary	Secondary	College and above
Using of Antibiotic (per batches)			
- 2 times	-	-	2 (14.3%)
- 3 times	1 (20%)	14 (66.6%)	11 (78.5%)
- 4 times	4 (80%)	7 (33.4%)	1 (7.2%)
Antibiotic Withdrawal Awareness			
- Yes	3 (60%)	15 (71.4%)	14 (100%)
- No	2 (40%)	6 (28.6%)	-
Who treats sick birds			
- Farmer	5 (100%)	14 (66.6%)	3 (21.5%)
- Veterinarian	-	7 (33.4%)	11 (78.5%)
Adding of coccidiostat to the feed (Finisher ration)			
- Yes	2 (40%)	16 (76.2%)	11 (78.5%)
- No	1 (10%)	-	3 (21.5%)
- Don't know	2 (40%)	5 (23.8%)	-

Vaccination and common diseases

There was no difference in vaccination types between two districts as survey revealed that all of the farmers vaccinated their broiler flock against Newcastle (ND), Infectious Bronchitis (IB) and Gumboro diseases. Whereas the common diseases symptoms that occurred in both districts were diarrhea, coughing and lameness. Also there was no difference in occurrence of these types of diseases between the two districts (table 15). On the other hand, there was no difference in mortality ratio between the two districts. However, all mortality came within range of 6 – 15 percentage.

Table 15: Types of diseases in both districts

ITEM	Location	
	Aljiza	Wadi As Sayer
Common diseases		
- Diarrhea	2 (10%)	4 (20%)
- Coughing	16 (80%)	13 (65%)
- Lameness	2 (10%)	3 (15%)
Mortality ratio		
- Less than 5	0	0
- 6 – 10	11	12
- 11 – 15	9	8
- More than 16	0	0

4.1.4 Hygienic practices

This section explains the effect of location, farmer's age and educational background on hygienic practices (replacement of footbath disinfectant, broiler house cleaning and visitors) in the both districts.

Effect of location

Table 16 showed that there was no different between farmers in both districts in term of footbath disinfectant replacement period. As research revealed that 85 % and 75 % of farmers had no footbath in farms in Aljiza and Wadi As Sayer districts, respectively. Some of them replaced the disinfectant of footbath twice per week because they allowed for visitors to enter the farms as they mentioned.

All the respondents in both districts pointed out that they cleaned and disinfected the broiler houses after the end of each production cycle and before receiving a new flock. Most farmers in both districts did not allow for visitors to enter the farm. For those four farmers in Wadi As Sayer district and one farmer in Aljiza who allowed for visitors they said they followed some biosecurity measures such as wearing long boot and using footbath disinfectant.

Table 16: Effect of location of farm on hygienic practices were followed by the farmers

ITEM	Districts		
	Aljiza	Wadi As Sayer	
Footbath			
- Twice per week	1 (5%)	2 (10%)	P=0.583
- Once per week	2 (10%)	3 (15%)	
- No footbath	17 (85%)	15 (75%)	
Clean house			
- Yes	20 (100%)	20 (100%)	
- No	-	-	
Allow for Visitors			
- Yes	1 (5%)	4 (20%)	
- No	19 (95%)	16 (80%)	

Effect of Age

There was no significant difference of using footbath disinfectant among different age range of farmers in both districts. The farmers within age range of 41-50 years used more footbath disinfectant compared with others, as described in table 17.

Table 17: Effect of farmers' age on farm biosecurity in both districts

Item	20 - 30	31 - 40	41 - 50	51 - 60	61 – 70	P-value
Footbath						
- Found of Footbath	-	1	5	2	0	P = 0.629
- No footbath	2	9	13	6	2	N.S.
Allow for Visitors						
- Yes	-	-	4	1	-	
- No	2	10	14	7	2	

N.S.: Not significant

Effect of educational background

There was no significant difference on using footbath disinfectant and for visitors' allowance among different educational background of farmers. Table 18 showed that only five secondary background's farmers allowed for visitors.

Table 18: Effect of education background of farmers on farm biosecurity in both districts

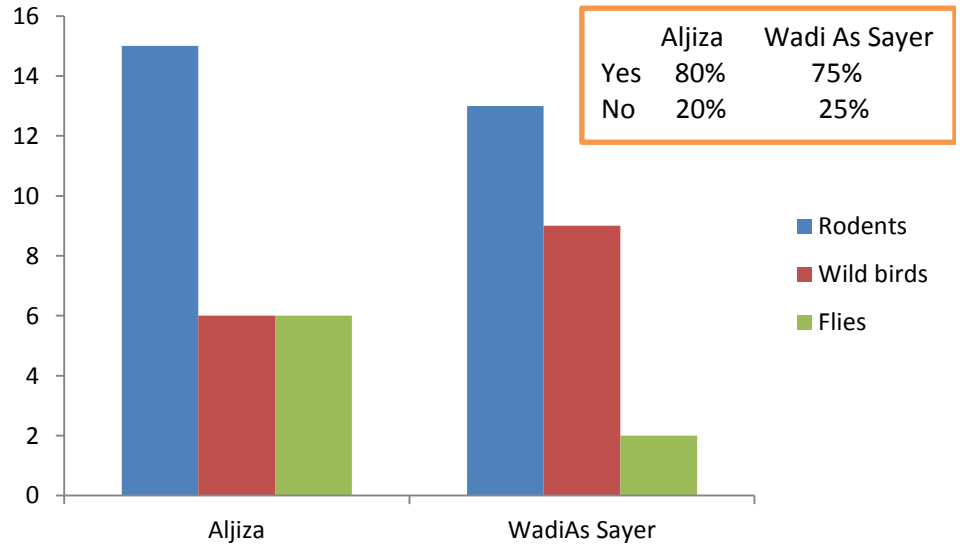
ITEM	Primary	Secondary	College	P-value
Footbath				
- Exist of Footbath	-	6	2	P=0.296
- No footbath	5	15	12	N.S.
Allow for Visitors				
- Yes	-	5	-	P=0.08
- No	5	16	14	N.S.

N.S.: Not significant

Pest and wild birds' problems

Figure 6 showed that 80% and 75% of farmers have pest problems in Aljiza and Wadi As Sayer, respectively. The rodent problem was the most common of pest problems occurred in Aljiza district. While the wild birds' problem occurred more in Wadi As Sayer district (Figures 6).

Figure 6: Pest problem existence



Personal hygienic practices in farm

The survey results revealed that some farmers utilized some of the suggested hygienic practices such as wearing of long boot and using of soap especially after using toilet. On

the other hand, all of these farms did not have the facility to disinfect the vehicles' wheels before entering the farm gate.

4.1.5 Waste Management

This part of results explains the effect of location, farmer's age and educational background on waste management (broiler manure and dead birds).

Effect of location

As table 19 described, all farmers in both districts managed their farm manure by selling it to plant farms. In winter they sell the manure to plant farms when the manure is needed for growing plants and in summer they pay money to get rid of manure. Whereas 45% and 55% of farmers managed the dead birds by sending them to waste dump or burning them in farm land in Aljiza and Wadi As Sayer districts, respectively. In general, most of farmers in Wadi As Sayer district managed the dead birds by sending them to the waste dump. The Ministry of Environment does not allow for burning method in Wadi As Sayer district because most of these farms are close to people houses.

Table 19: Manure and dead birds' management in both districts

ITEM	Location	
	Aljiza	Wadi As Sayer
Manure management		
- Sell to farms	20 (100%)	20 (100%)
- Sell to manure factories	-	-
Dead birds		
- Waste dump	9 (45%)	14 (70%)
- Burning	2 (10%)	0 (0.0%)
- Waste dump + burning	9 (45%)	6 (30%)

Effect of farmers' age

Most farmers within age range of 41- 50 years managed dead birds through waste dump and some of them by burning methods (table 20).

Table 20: Dead birds management according to farmer's age

ITEM	20 - 30	31 - 40	41 – 50	51 – 60	61 – 70
Dead birds					
- Waste dump	1	4	12	4	2
- Burning	-	-	2	-	-
- Waste dump + burning	1	6	4	4	-

Effect of farmers' educational background

Table 21 showed that there was no significant difference on waste management among different educational background of farmers. Most the secondary and college

background's farmers managed the dead birds by sending them to waste dump. Some of them used burning method. For manure management all farmers have one choice by selling it to the plants farms.

Table 21: Dead birds management according to farmer's education background

ITEM	Primary	Secondary	College and above	P=Value
Dead birds				
- Waste dump	2	13	8	
- Burning	-	2	-	P=0.551
- Waste dump + burning	3	6	6	

4.2 Broiler traders

Broiler traders are usually found a round the small scale broiler production facilities where in most cases the farmers do not have transportation facilities. In the current study, four traders were interviewed, two from Aljiza and two from Wadi As Sayer district. The traders are usually buying the birds from the farms and selling them to Natafat. The interviews revealed that there was no difference regarding the hygienic practices for broiler loading, unloading and transportation between the two districts.

The traders mentioned that they usually transport the birds during the night and/or early mornings because it is much easier to catch the birds when it is dark moreover, to avoid the effect of high temperatures during day time. On the other hand, it was mentioned that period of transportation is between 1.5 – 3 hours. However, in some cases more time was required.

It was mentioned that feed withdrawal at least for two hours was recommended before collecting the birds to reduce the contamination of feather and carcass with feces during transportation and to avoid the bad smell of feces contaminating birds. Usually, picking up the birds is done gently to avoid bruising of the flesh and bones breakage. Also, it was mentioned that traders wash the vehicles and crates by water once a week while they sweep the feces and feather daily. Regarding the personal hygiene, it was mentioned that they wear clean clothes but not a uniform daily and they take a shower after they finish the transportation.

Based on personal observations, it was very clear that traders do not implement the biosecurity standards for diseases transmission among farms since they did not clean and disinfect the vehicles and crates daily. On the other hand, workers do not implement the personal hygienic practices as they do not wear uniform clothes, nose mask nor do they disinfect their hands before they start loading trucks.

4.3 Natafat

This case study was conducted on small processing units (Natafat) in the two districts. The total Natafat were 30 units in Aljiza and 15 in Wadi As Sayer. However, for the research purpose, five units from each district were chosen randomly. The interviews revealed that there was no big difference in personal background of Natafat's workers between the two districts. The average age for the slaughter-man in Aljiza was 36.2 year and 35.8 year in Wadi As Sayer. Most of these workers in both districts have the secondary educational background. As observed most of Natafat workers in Aljiza and Wadi as Sayer districts are from Egypt and they have the experience of working in

slaughtering broilers from Egypt. As most of them came from rural areas and worked in broiler slaughtering shops before.

It was noted that there was no difference between Natafat in both districts in terms of hygienic practices. As most of workers wear clean clothes daily, use soap to disinfect their hands after using the bathroom and all have been medical certified by the ministry of health. On the other hand, workers do not use soap before slaughtering birds, nor they wear gloves. It was noticed that the construction of Natafat building especially the floors in Wadi As Sayer district are easier to clean as compared to those in Aljiza district. Regarding the waste management, all of Natafat workers collected the waste in big plastic bags and then dispose them in domestic rubbish containers.

Tables 22 and 23 show the background information and hygienic practices of Natafat in the two districts.

Table 22: Natafat Hygienic practices and background information

No.	Questions	Aljiza	Wadi As Sayer	Total
1	Worker age			
	- 20 - 30	2	1	3
	- 31 - 40	2	4	6
	- 41 – 50	1	0	1
	$\bar{x}$ ± SD	36.2 ± 7.6	35.8 ± 6.1	
2	Educational background			
	- Primary	1	1	2
	- Secondary	3	4	7
	- College	1	0	1
3	What are the requirements of the government?	Ventilation, Natafat's walls, floor and ceiling should be easy to clean, Medical health certificate and the place should be clean		
4	How do you manage the broiler waste?	Domestic rubbish		

Table 23: Natafat hygienic practices in both districts

No.	Hygienic practices by slaughter man	Aljiza		Wadi As Sayer		Total
		Yes	No	Yes	No	
1.	Do the chicken inspect before or after slaughtering by a veterinarian or an expertise in poultry?	0	5 [y]	0	5	10
2.	Do you clean and disinfect all the surfaces and facilities before and after slaughtering?					
	- Clean	5	0	5	0	10
	- Disinfect	2	3	3	2	10
3.	Do you wear clean clothes, head cover and cloves during slaughtering process?					
	- Clean clothes	5	0	5	0	10
	- Head cover	0	5	0	5	10
	- Cloves	0	5	0	5	10
4.	Do you wash your hands with soap after toilet and before enter to slaughtering unit?					
	- After toilet	5	0	5	0	10
	- Before enter slaughter unit	0	5	0	5	10
5.	Do you know about the basic hygiene practices?	5	0	5	0	10
6	Is the Natafat wall and floor easy to clean?	2	3	4	1	10

y: Number of Natafat interviewed, five from each district.

4.4 Ministry of Agriculture (Poultry Division)

According to the poultry division officer interview, Jordan has nine big broiler slaughterhouses with a total capacity of 32.5 thousand birds / hour and which is corresponding to 55% of total broiler production in the country as described in section 2.8 chapter 2.

Poultry division officer mentioned that there are some differences in the broiler farms between Aljiza and Wadi As Sayer districts. The broiler farms in Aljiza district are more commercial than those in Wadi As Sayer district. Aljiza has some large scale farms such as the National Poultry Company which has the capacity of 800,000 birds per production cycle. Also Aljiza has some big feed factories such as the National Poultry Company (feed factory branch), Provimi and Sinokrot companies. Whereas, most farms in Wadi As Sayer are family business and small scale farms.

On the other hand, the poultry division officer mentioned that the food safety risks and poor agricultural practices associated with broiler farms are summarized to the following points:

1- The microbial contamination of meat with some bacteria such as *Salmonella* and E. coli, usually farms are the direct source of contamination.

2- Antibiotic residues in broiler meat (Most of these farms did not implement withdrawal period of antibiotic).
3- Coccidiostat residue in broiler meat (most of these farms used coccidiostat up to slaughter time)
4- Some poultry farms are closed to each other.
5- Poor biosecurity practices in small scale farms.
6- Most of workers did not know about the personal hygienic practices.
7- Poor feed storage conditions.
8- Poor farm infrastructure as most of these farms is old.
9- Most of walls and floor contain cracks which can be a source of microbial contamination.

The Ministry of Agriculture's strategy is to reduce these food safety risks which are associated with broiler meat in farm and in broiler slaughterhouses by increasing the awareness for food safety and Good Agricultural Practices (GAPs). The Ministry encourages a use of new technology in broiler production and slaughtering processes, such as large scale farms and automated slaughterhouses.

Some of the Ministry of Agriculture regulations for the broiler farms:

1- The main authority responsible for implementing these regulations is the Ministry of Agriculture also Ministry of Environment and Ministry of Municipalities Affairs have a specific role to play in establishing new farm.
2- Broiler farms must be constructed far away from residential areas.
3- New farm must have at least a capacity of 5,000 birds to ensure that farm will invest a sufficient capital and the farm is suitable to produce on economic basis.
4- The farm must contain a clean source of water; each house should have a big water tank.
5- The house construction must be suitable and comfortable for broiler production.

The poultry division officer mentioned that the Ministry imposed on broiler farmers to manage their dead birds by sending them to a governmental waste dump. In regarding of the broiler manure, the officer pointed out that farms sell the manure to other farmers as a fertilizer for crops and trees. In cases of contravention, that farm will be fined and the Ministry of Agriculture has the authority to withdraw the license of the farm.

4.5 Amman Municipality (Food Safety Committee)

According to the food safety committee the main authority responsible to monitor and implement the regulation of the Natafat in Amman province is the Municipality of Amman. Ministry of Environment and Ministry of Health have some role to play in term of environmental issue and human health, respectively.

The Municipality's goal is to improve the food safety of broiler meat in Amman. Currently, there is a policy to encourage building modern slaughterhouses while, stopping or decreasing the Natafat business but this strategy faces some problems:

- Most of Natafat work is located in poor areas and it's a source of employment for those people.
- The capacity of big slaughterhouses is less than the broiler production in country
- There is a segment of people prefer the Natafat broiler meat especially for its price and freshness.
- Natafat is easy to access by small scale broiler farmers.

Amman Municipality has a big broiler slaughterhouse with capacity of 2,500 birds / hour in the center of Amman (table 4). The goal of this slaughterhouse is to absorb the small scale broiler farms production.

The food safety committee in the Municipality mentioned that they inspect on the Natafat biweekly. Also it was mentioned that the food safety committee receive a lot of complaints from people about the foul smell of the Natafat due to the bad waste management and flies.

According to the Food safety committee, the Natafat has poor hygienic practices which could be a source of food safety risk. Microbial risk factors such as contamination of meat with *E coli*, *Salmonella* and *Campylobacter* come as a major concern. Also, poor hygienic slaughtering practices such as scalding water was not clean and birds bleeding cones was dirty with feather and blood. The drainage system is not efficient to drain all the water in Natafat. Most of workers were not aware of the basic knowledge about the food safety and foodborne diseases. Also, the food safety committee indicated for the risk of the Highly Pathogenic Avian Influenza (HPAI) prevalence on human health since these Natafat are placed within residential houses.

The Amman Municipality's regulations regard food safety on Natafat

1- The construction of wall, ceiling and floor must be easy to clean
2- Good ventilation, especially the place has live birds
3- Medical health certificate for workers
4- The place must have adequate drainage system for the waste water
5- Natafat contain a water sink
6- Workers must wear clean clothes
7- The place of Natafat and slaughtering equipment need to be always clean
8- Managing of broiler waste by selling them to the pet feed or fertilizer factories and not allow to mix them with domestic rubbish

4.6 Broiler farms observations

Criteria	Requirements	Aljiza District	Wadi As Sayer District
Feed	1- Wild birds, insects and rodent cannot access feed	Poor	Poor
	2- Storage place free of wet	Moderate	Moderate
	3- Feed rising on pallet	Poor	Poor
	4- There is no risk of cross contamination	moderate	Poor
Water	1- Water in drinkers is clean 2- Source of water is safe from wild birds and insects 3- Water system is proper protected from litter contamination	Good	Moderate
Building	1- The building constructed well and easy to clean and disinfect.	Poor	Poor
	2- Provide adequate space for birds 3- Appropriate ventilation and light	Good	Good
	4- Each house has a footbath disinfectant	moderate	Poor
	5- The place of farm is far enough from other farms	Moderate	Moderate
Equipment (Drinkers & feeders)	1- Equipment is enough for all birds and distributed in suitable places.	Good	Good
	2- Equipment is clean	Moderate	Moderate
Personal hygiene	1- Clean uniform and long boot are used by workers	Poor	Poor
	2- Soap using before feeding birds	Poor	Poor
	3- Soap using after toilet	Good	Good

-Three point scale measurement is used (Good, Moderate and Poor) to explain the observation in broiler farms

Figure 7: Observations on broiler farms

a) Internal view of broiler house

b) Internal view, windows, feed is storing inside the house of broiler

c) Broiler farm worker

d) External view for the broiler house

Source: Compiled from the observations

4.7 Natafat observations

Criteria	Requirements	Aljiza District	Wadi As Sayer District
Broiler inspection	1- Inspection of birds by veterinarian or expert person before slaughtering	Poor	Poor
	2- Inspection of birds before slaughtering[4] (Natafat's worker)	Moderate	Moderate[5]
Bleeding time	1- Two minutes are necessary to bleeding before de-feathering	Good	Good
Time of delivery the birds	1- Delivery of birds during night and early morning is good for reducing the effect of high temp.	Good	Good
Building	1- Walls and floor are constructed in a way that ease cleaning process 2- The slaughter place is clean 3- Slaughtering machines are clean	Poor	Moderate
Scald tank	1- Water is clean	Poor	Moderate
Personal hygiene	1- Clean uniform and long boot are used by workers	Moderate	Good
	2- Gloves and head cover are used by workers	Poor	Poor

-Three point scale measurement is used (Good, Moderate and Poor) to explain the observation in Natafat

[4] The Natafat worker inspects all birds for external symptoms (not by veterinarian. Sick and dead birds will change by the broiler supplier with good birds.

[5] Moderate because it is depend on labor skills and external symptoms

Figure 8: Observations from Natafat

a) Birds bleeding cones

b) Live birds in Natafat

c) Worker wash the broiler carcasses

d) De-feathering machine

Source: Compiled from the observations

4.8 Assessment of all observations in both districts

The overall observations in farms and Natafat in both districts showed that Aljiza broiler farms are better than Wadi As Sayer broiler farms in regard to hygienic practices. Whereas, the Natafat in Wadi As Sayer are a little bit better than those in Aljiza in term of broiler meat safety as described in table 24. This type of assessment based on the observations that found in sections 4.6 and 4.7.

Table 24: Assessment of all observations in broiler farm and Natafat in both districts

	Criteria	Aljiza	Wadi As Sayer
Farm	**Feed**		
	-Feed cannot be accessed by rodents	+	+
	-Feed storage conditions	++	++
	-Using pallet	+	+
	-No risk of cross contamination	++	+
	Water		
	-Water is clean and it's source is safe	+++	++
	Building		
	-Surface of walls and floor easy to clean	+	+
	-Spaces for birds	+++	+++
	-Footbath exist for each house	++	+
	-Farm is enough far from other farms	++	++
	Equipment		
	-it is enough for all birds	+++	+++
	-it is clean	++	++
	Personal Hygiene		
	-Worn clean uniform clothes	+	+
	- Soap using before feeding birds	+	+
	- Soap using soap after toilet	+++	+++
Total		**27**	**24**
Natafat	**Broiler Inspection**		
	-Inspection by Veterinarian	+	+
	-Inspection by workers	++	++
	Bleeding time	+++	+++
	Delivery time	+++	+++
	Building	+	+
	De-feathering water	+	++
	Personal hygiene		
	- Clean uniform	++	+++
	- Gloves and head cover	+	+
Total		**14**	**16**

Three points scale measurement in previous table was used Good (+++), Moderate (++) and Poor (+)

4.9 Small scale commercial broiler supply chain

The data of research was used to formulate the stakeholder analysis and supply chain map (Figure 9).

Stakeholders Analysis

The main stakeholders of small scale commercial broiler chain in Amman province are the input suppliers, broiler producers, processors and retailers (Natafat) and consumers. The government of Jordan which represented by Ministry of Agriculture, Amman Municipality, JFDA and the Ministry of Environment are the main influencers. Whereas, the Jordan Credit Corporation (JCC) and JPPA are the main supporter of the producers (Table 25)

Table 25: Stakeholders analysis

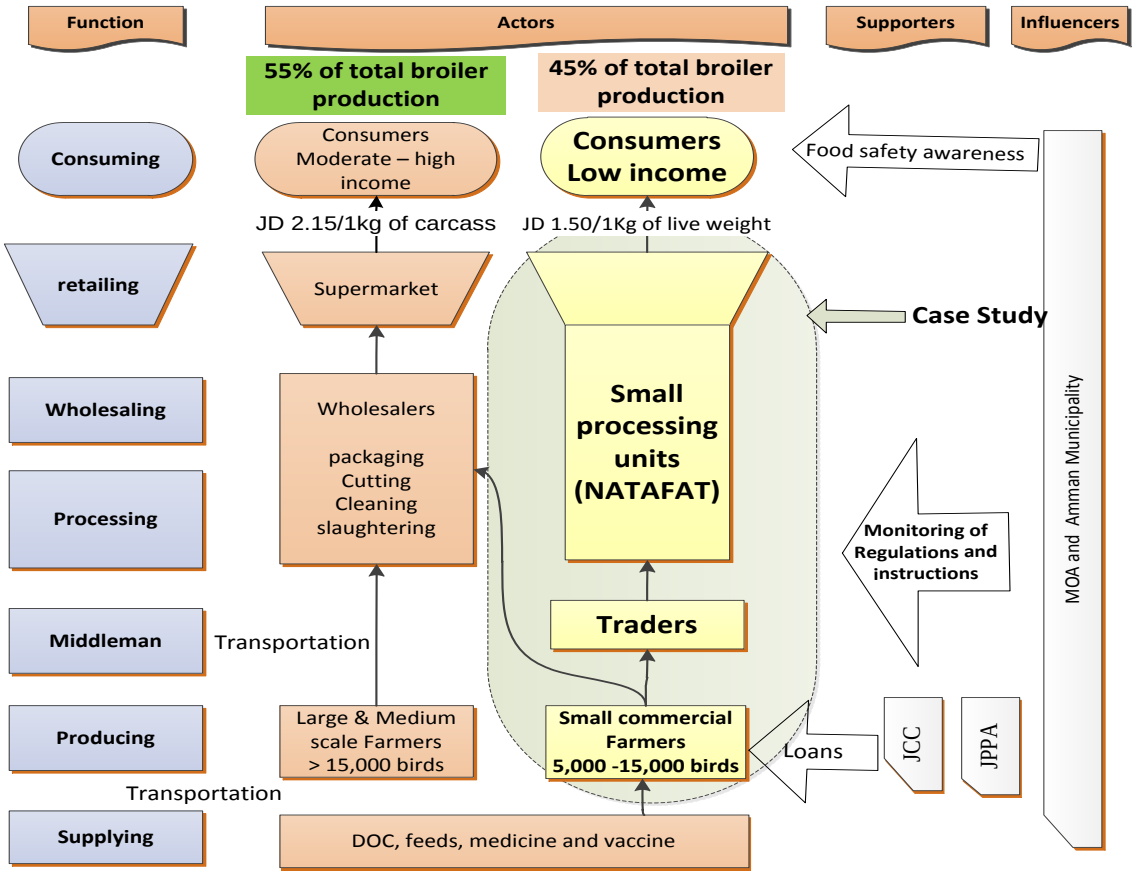
	Stakeholder	Role	Function	Specifications and Remarks
Actors	Hatcheries	Input suppliers	Supply the farms with DOC[a]	All of these hatcheries are part of integrated poultry companies such as ACOLID, Aljazera and National Poultry Company - Jordan has 46 hatcheries with a capacity of (288.35) million chicks / year
	Feed companies	Input suppliers	Supply the farmers with grain (corn and SBM[b]) and broiler feed	-Most of these factories are part of big integrated livestock companies -Jordan has 25 big feed factories
	Drugs stores	Input suppliers	Supply the farms with vaccine and drugs (antibiotic, coccidiostat) and vitamins	-Jordan has 21 drugs factories and many of drugs stores - No control in drugs administration
	Small broiler farmers	Producers	Produce broiler meat	-Capacity of farm 5,000 – 15,000 birds/ cycle. -80% of Amman farms are small (80% * 325 farms) = 260 farms
	Traders	Middlemen	Buy chicken from farmers and sell to the Natafat units	-They have transport facilities - Work around the small-scale broiler farms - Unregistered and they do not have licenses
	Natafat (small processing units)	Processors and retailers	In these shops, consumer choose live birds and the worker slaughter, cut and put the birds carcass in small bag	-It's in poor and moderate income people areas

	Big slaughterhouses	Processors	Produce chilled and frozen broiler meat	-Jordan has 9 slaughterhouses with capacity of 32,500 birds/hour -Produce good hygienic meat -They are part of big integrated companies -Part of small scale farmers sell their products to these slaughterhouses
	People in Amman province	Consumers	- Consume the broiler meat of Natafat units	Poor and moderate income people
Influencers	Ministry of Agriculture, Municipality of Amman, Ministry of Environment and JFDA	Influencers	Monitoring the small farmers to implement the regulations	Governmental institutes
Supporters	JCC	Supporter	Provide loans to small farmers with low rate	Governmental institute
	Jordanian Poultry Producers Association	Supporter	-Representative (represent all farmers in negotiation with other stakeholders)	-Farmers' Association -Established in 2005

a DOC: Day Old Chick

b SBM: Soya bean Meal

Figure 9: Small-scale commercial broiler chain in Amman province



Source: Compiled by the field study
Jordanian Dinar (1JD = 1.10 €uros)

4.10 Risk Assessment

The risk analysis tool was used to determine the potential of broiler meat safety hazards that can happen within three actors in small commercial broiler chain (broiler farm, trader and Natafat) as described in tables 26 & 27. The colours and numbers in figure 10 are used to distinguish the potential of hazards. However the moderate and high hazards are considered as the potential hazards for broiler meat that threaten the meat consumers. Whereas the low hazards are not significant and do not need to be considered. These data are used in risk assessment tool based on the field research.

Formula of Risk Analysis = Frequency (F) x Impact (I)
Frequency (F): the occurrence of the hazard
Impact (I): the severity of the hazard

Figure 10: Risk assessment grid

	Impact on quality		
Frequency of hazard appearance	**low 1**	**medium 2**	**high 3**
never 0	0	0	0
low (exceptional) 1	1	2	3
medium (possible) 2	2	4	6
high (frequent) 3	3	6	9

Source: Schoenmakers, 2009
Notes: Hazard score between 0 – 2 is low and not significant hazard, 3 – 4 is moderate while hazard 6 – 9 is high.

Table 26: Broiler farm risk assessment in Aljiza and Wadi As Sayer districts

Hazards Type	Hazards	F	I	F*I	Potential Risk
Biological	• Bacteria (*Salmonella*) **Source**: parent stock and hatcheries	1	2	2	Low risk
	• Bacteria (*E coli*) **Source**: hatcheries	1	2	2	Low risk
	• Virus and Bacteria (*Salmonella*, ND and *E coli*) **Source**: inappropriate clean and disinfected broiler house	1	2	2	Low risk
	• Pathogenic bacteria (*Salmonella* and *campylobacter*) **Source**: wild birds and pest animals	2	2	4	Moderate risk
	• Pathogenic bacteria (*Salmonella* and *campylobacter*) **Source**: inappropriate biosecurity such as visitors	2	2	4	Moderate risk
	• Pathogenic bacteria (*Salmonella* and *campylobacter*) **Source**: inappropriate personal hygiene	2	2	4	Moderate risk
Chemical	• Mycotoxines (Aflatoxins, Orcharatoxins, Trichothecenes, Zearalenone and Fumonisinsin,) **Source**: Feed and poor storage feed conditions	1	2	2	Low risk
	• Medicine residues **Source**: Administration of antibiotics by the farmers	3	3	9	High risk
	• Coccidiostat residue **Source**: Administration of coccidiostat by the farmers	3	3	9	High risk
	• Pesticides residue **Source**: feed	1	2	2	Low risk

Table 27: Natafat risk assessment in Aljiza and Wadi As Sayer districts

Hazards Type	Hazards	F	I	F*I	Potential Risk
Biological	• Bacteria (*Salmonella* and *Campylobacter*) **Source**: None inspection chicken before slaughtering.	3	3	9	High risk
	• Bacteria (*Salmonella*, *Campylobacter* and *E coli*) **Source**: chicken feather contaminate with feces during transportation	3	2	6	High risk
	• Pathogenic bacteria (*Salmonella*, *Campylobacter* and *E coli)* **Source**: improper evisceration of carcasses by hand	2	3	6	High risk
	• Pathogenic bacteria (*Salmonella*, *Campylobacter* and *E coli*) **Source**: cross contamination with previous birds	2	3	6	High risk
	• Pathogenic bacteria (*Salmonella* and *Campylobacter*) **Source**: inappropriate personal hygiene	2	3	6	High risk
	• Pathogenic bacteria (*Salmonella* and *Campylobacter*) **Source**: poor hygienic practices at Natafat	2	3	6	High risk

According to the risk assessment tool, most of the risks associated with broiler meat at farm level are potential hazards as most of them are moderate and high (some risks are low). In Natafat all of the risks are potential hazards as all the risks associated with broiler meat are high risk.

CHAPTER 5: DISCUSSION

5.1 Background of broiler farmers

The result showed that farmers have quite high literacy levels which comply with a high literacy percentage (90%) in Jordan (DoS, 2010). While the average age is not expected as it was high especially in Wadi As Sayer district because most the farms are family businesses and the owners are retired. The number of production cycles was lower than that of fully integrated large-scale broiler companies (5 vs. 7 to 8, respectively) (Hosny, 2006). The low number of cycles in such facilities was due higher production cost during winter due to extra heating cost.

The group of farmers' age ranged between 41 – 50 years was more aware of meat safety and produced safer products as compared to other groups, this could be explained by the fact that this group had higher educational levels (college or secondary school). The results of this study showed a strong relation between educational level and implementation of food hygienic practices, the results obtained in this study agree with the finding of Tajick (2006) who emphasized that advanced education of poultry farm workers is necessary to avoid food safety risks.

In term of location, the result showed that Aljiza farms are more committed with food safety issues such as biosecurity practices than those in Wadi As Sayer, this could be explained by the fact that farms at Aljiza district are more commercialized.

Food safety at farm level

The main practices which are important to eliminate the effect of microbial and chemical hazards at farm level are good management of feed, health of flock, broiler farm waste, biosecurity and personal hygiene. Bolder (2007) stated that it is very important that broiler chicken is pathogenic free at farm level to control or minimize the potential of producing pathogenic contaminated meat at slaughterhouses

Feed management

Feed which prepared in feed factories were more hygienic than feed which was prepared at farms as these factories were implementing GMPs and the instruction of Ministry of Agriculture (instruction No. (Z/18) of 2003 for feed manufacture and trading which complies with Agricultural Law No. 44 of 2002). Whereas there was no control on feed preparation at the farms level. The research revealed that there were two critical control points at farm level which could contribute the food safety risk and threaten the consumer's health. First, the inappropriate feed storage conditions which can cause mycotoxins in the feed and later in the meat; it was observed that farmers stored feed inside the broiler house without using pallets (Figure 7, b). Farmers stored the feed there because it was easier for them to feed the birds and in most cases they were out of storage place for the extra feed. Second, majority of farmers administered the coccidiostat up to slaughter time without allowing a withdrawal period because they thought that this practice improves feed conversion ratio. It is worth mentioning that most farmers had low awareness about coccidiosis treatment since most of them added coccidiostat to feed and they were not aware of vaccination. Khelfa (2011) focused on the benefit of using of vaccination in controlling coccidiostat as compared to drug added in the feed. Imported feed is tested for pesticides residues, aflatoxin and pathogenic

bacteria such as *E. coli* and *Salmonella* by the Poultry division (Ministry of Agriculture). However, there is no governmental test for antibiotic or coccidiostat residues in meat.

Flock health management

The findings of this research revealed that farmers implement some of hygienic practices at farm level as they committed to preventing visitors from entering the farm premises and applied vaccination program, but this was not enough to minimize the foodborne diseases prevalence. Most farmers did not use a footbath disinfectant and in most cases they used drugs without veterinarian prescriptions. These practices could be a result of low awareness on the importance of footbath disinfectant and drugs administration by veterinarian prescription in minimizing diseases prevalence. Furthermore, these practices could be a reason for diarrhea, coughing and lameness diseases in the farms. Another important issue which could contribute in disease prevalence and in reinfect the subsequent flocks was the bad construction of the walls and floors of broiler houses as they have cracks and could be a source of microbial contamination.

Drugs administration without adhering to withdrawal period is a critical control point and could contribute in broiler meat risks. The farmers use drugs according to the health status of flock until marketing day without paying attention to the withdrawal period of drugs and they gave a reason for that since traders do not buy unhealthy birds.

Broiler waste management

The result showed that farmers managed their dead birds by burning or by disposing them in the governmental waste dump. Some farmers consider the burning method is easier and cheaper as compared to send the dead birds to the waste dump which was located about 50 km[6] away. This practice creates a conflict with Ministry of Environment as the burning method can contribute in air pollution and disturbing people as most farms in Wadi As Sayer district are close to residential areas

Another issue which was practice by farmers is collecting the dead birds for few days at the farm before disposing them. This practice could lead to diseases transmission within the flock and among other farms. On the other hand, the way farmers managed broiler manure was by selling the manure to the crops and trees farms without any treatment, which could lead to pathogen transmission Charlesl (n.d) reported that manure should be compost to reduce pathogens transmission.

5.2 Traders

Broiler traders work as middlemen as they market the whole flock to the Natafat and some of them have own farms. Most traders were unregistered and worked without governmental license. Generally, anyone can perform this kind of job in Jordan as long as he has a transportation facilities and good relations with broiler farms owners and Natafats owners. So the hygienic practices which are implemented by the traders depend on how they can deliver the broiler chicken to the Natafat in a proper way. The disease could be transmitted at Natafat is through the way Natafat handles sick or dead birds. Natafat workers collect dead and sick birds in one corner of Natafat to return to the trader when he brings new batch of birds, usually next day, which could lead to infect new birds.

[6] Km = kilometre

The result showed that traders' movement among farms was unrestricted, no agreement with farm to withdraw the feed before loading and no disinfection of the crates and the vehicles after each transportation was applied. These practices could contribute to spread foodborne disease especially HPAI which it's virus can survive in manure for three months in cool temperature (WHO, 2006). Also Hanson *et al* (2005) found the inappropriate disinfection of crates and vehicles could contribute in *Campylobacter* and *Salmonella* transmission from one flock to the next. These practices have been done due to lack of governmental control and low awareness about the diseases transmissions.

One trader said "*The farmers allow for the traders' vehicle to enter the farm even farmers know that the vehicle was not disinfected, because they think that this practice was not dangerous as the flock is leaving the farm and the house will be disinfected*". In fact, these vehicles can bring new diseases to the farm and can cause a new problem for the next flock or transmit pathogens to meat products. The old proverb said "*Prevention is better than cure*".

However, the result showed that some good hygienic practices were implemented by the traders such as transporting the broiler birds during the night and within a short time period (1.5 – 3 hours). These practices comply with GHPs of (EPIG, 2010) and (FAO, 1992). Actually, the traders implemented this practice because the night is assisting them in catching the birds not because they awareness for GHPs.

5.3 Natafat

The hygienic practices for birds slaughtering in Natafat are not only necessary for broiler meat safety concerns but also for the workers' health. The results highlighted some control points that are important towards the food safety and foodborne diseases prevention. Birds' inspection, slaughtering practices, birds bleeding, broiler waste management, scald and evisceration can be the control points in Natafat.

The result revealed that Natafat have some good hygienic practices such as wearing long boots and long dress and inspecting the live birds before and after slaughtering process for any damage in birds' carcass. This inspection carries out by worker and it is feasible for external symptoms, while according to (EPIG, 2008) the inspection should be done by veterinarian. These practices are not completely complied with GHPs of (EPIG, 2008). According to the reesearcher's observation, in Natafats nobody use gloves, hands disinfectant or soap before slaughtering birds and before carcass cutting. Also the Natafat could be a source of cross contamination as most of Natafat walls and floors are not constructed well so they are not easy to clean and disinfect. The low educational level of workers and weakness of inspection could be the main reasons for poor hygienic practices.

The worker slaughters the bird in front of consumer and put it in bleeding cones until the chicken completely bleed out. The process takes about 4 to 6 minutes which complies with the recommendations of (Pescatore, 2011). Slaughtering un-inspected birds in unhygienic place with exist of people can contribute in foodborne disease (Kiilholma, 2007).

Furthermore, the Natafat workers collected the broiler waste in big plastic bags, closed them tightly and then throw in domestic rubbish at the end of the day. This can be a

source of flies and bad smell. In fact, it is difficult for Natafat to find another source for waste management and it needs of Municipality cooperation to resolve this problem.

When the bird has completely bled out, it is removed from the bleeding cones and put in scald tank. It was observed, the water of scald tank was not clean as the workers change it once or twice daily and some of them just add new water to the tank. So the water of scald tank could be a source of microbes and leads to cross contamination of following carcasses. In general, Natafat owners try to reduce the cost of slaughtering process to increase the profit. It was estimated that the revenue for each 1 kg of live birds' weight is 15 cents.

Eviscerations of broiler was done in an improper way by hands, the worker open the body cavity and remove the entrails out, at the same time the worker cut the carcass into small parts without using gloves or washing his hand with disinfectant or soap. This could be effective in carcass contamination with internal parts microbes. Moreover, there is no inspection for these cuts and internal edible parts such as liver and gizzard.

The washing step in Natafat was done by using tap water which is clean and potable. As observed, the amount of water used in carcass washing is a little and not enough for *Salmonella* removal or decline the number of pathogenic microbes. On the other hand, it could be difficult on Natafat to use chlorine in washing of carcasses to reduce the population of microbes, because the consumers do not accept using any chemicals as they think that will affect the meat smell.

In Natafat, there is no chilling step as it is needed by consumers to re-wash the carcass at home in order to become ready for cook or storing in fridge. So any delay from the consumer will increase the population of microbes and could cause foodborne disease. Also, the hot weather of summer in Jordan and non-vacuum packaging accelerate the meat spoilage.

5.4 Amman Municipality (Food safety committee)

Generally, the food safety committee expressed that the policy of government is focusing on encouraging people to consume the chilled or frozen chicken through supermarkets. These chickens are produced by good hygienic slaughterhouses which work under the instruction No. (Z/16) of 2003 for licensing of poultry slaughterhouses which is complying with Agricultural Law No. 44 of 2002 and the law of JFDA Act; 31/2003.

The food safety committee indicated that the main concern of food safety hazards is that there is no ante- and post mortem inspection. This practice can consider a critical control point as it is importance in foodborne diseases prevention. The OIE report emphasized on that inspection of slaughter animals can control and/or reduction of hazards of public health (OIE, 2008). In fact, there is no data available on foodborne diseases by broiler meat consumption at home. On the other hand, the Municipality does not have the required facilities to inspect all Natafat's birds.

Also the officer pointed out that the broiler waste[7] could be a big problem while most of Natafat workers throw the waste in domestic rubbish. This agrees with the report of

[7] broiler waste (feather, blood and evisceration waste)

Allshawabkeh (2010) which clarified that there are many complaints on improper way of Natafat's waste management.

Food safety committee indicated that the Municipality staff inspect on the Natafat every two weeks. In case, they received any complaint from consumers towards a Natafat, they increase the number of inspection for that one. They check on the hygiene level of the Natafat place, personal as well as the medical certificate. Actually, the inspection is for general cleanness of place and there is no inspection on slaughtering hygiene practices or on health status of birds. On the other hand, Municipality just fines the Natafat which is not comply with Municipality regulations but it does not prefer to ban the Natafat because of its concern of poor economic situation of the Natafat owners.

5.5 Ministry of Agriculture (Poultry Division)

The poultry division ascertain on that poultry farms must comply with the Ministry instruction No. (Z/4) of 2002 to issue License for poultry farms which follows the Agricultural Law No. 44 of 2002. This instruction emphasises on the farm to produce in proper way.

The Poultry Division staff mentioned that the drugs and coccidiostat administration by the farmers as a major food safety risks could be associate with broiler meat production at farm level. This is due to the fact that farmers know that there is no control on drugs administration and no test on antibiotics residues. The results showed that farmers prefer to decrease drugs use in broilers due to the high cost rather than hygienic purpose. While the addressing diseases by farmers without veterinarian prescriptions could be a reason for extensive use of antibiotics and this leads to antibiotic residues in the meat broiler.

The poultry division officer mentioned that there is cooperation between the Ministry of Agriculture and Municipality of Amman in monitoring the broiler farms waste (manure and dead birds). The Ministry imposes on farmers to dispose the dead birds in governmental waste dump whereas some farmers managed the dead birds by burning method. Also, some farmers get rid of these birds by feeding it to dogs, this practice could result in the virus to go cross species and mutate in other animals (WHO, 2006).

Farmers sold the untreated manure as they know this manure can be a source of microbial contamination. In this case, the selling manure which is contaminated with pathogens could be a source for diseases transmission and other food stuff contamination, Nicholson, F.A., Groves, S.J. and Chambers, B.J. (2005) found the *Salmonella* in manure could survive for up to one month in cultivated lands.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions:

The study evaluated the hygienic practices in two districts to come up with a clear picture for the small scale broiler chain contribution in food safety improvement in Amman province.

The study pointed out a number of chemical and biological hazards associated with the broiler meat production in Amman province. **At farm level**, the chemical hazards are antibiotic and coccidiostat residues and mycotoxins as well as *Salmonella*, *Campylobacter* and *E*. *coli* as biological hazards. **At Natafat level**, the potential hazards are *Salmonella*, *Campylobacter* and *E*. *coli*.

On the other hand, the study revealed that the following practices contribute in meat safety risks in small scale broiler chain in Amman province:

Broiler farms: (1) Pest and wild birds problems, (2) omitting of footbath disinfectant, (3) administration of coccidiostat up to slaughter age, (4) administration of antibiotic without any consideration of withdrawal period, (5) addressed of disease symptoms and drug application by farmers without veterinary prescription, (6) poor personal hygienic practices (no uniform clothes, soap and hand disinfection), (7) accumulation of the dead birds for few day in farm before dispose them in waste dump, (8) many of broiler houses have cracks, (9) improper feed storage conditions, (10) some farmers do not withdraw feed before slaughter.

Broiler traders: (1) poor personal hygienic practices such as: no mask, hand disinfection and uniform clothes. (2) No cleaning nor disinfecting of crates and vehicle after each transport

Natafat: (1) no disinfection of the cages that contain live birds, (2) poor personal hygienic practices (nobody uses gloves, head cover, (3) no hand disinfection before slaughtering and cutting the carcass), (4) poor disinfection of Natafat place, (5) no disinfection of slaughter equipment, (6) some Natafat walls construction are hard to clean, (7) improper way of waste management.

On the other hand, there are some good hygienic practices done in small scale broiler chain. These contribute in food safety improvement and reduce the potential hazards.

Broiler farm: (1) clean and disinfect the broiler houses before each cycle, (2) biosecurity practices (all in all out of birds and prohibition of visitors by most farmers), (3) implement of vaccination program, (4) treatment of sick birds, 82% of farmers withdraw the feed before loading the birds, (5) the broiler feed was formulated according to the NRC[8] recommendations.

Broiler traders: (1) transportation of the birds occurred during the night and within short time (1.5 – 3 hours). (2) The traders provided enough space for birds in the crates, (3) they catch the birds in a proper way.

[8] NRC: National Requirement Council U.S.

Natafat: (1) The positive aspect of Natafat is a proper bleeding time, (2) the inspection of birds before and after slaughtering done by workers, (3) using of long boot and long plastic dress, (4) the workers have a medical health certificate.

The small scale broiler supply chain in Amman province consist of the input suppliers, broiler producers, traders, Natafat as processors and retailers, and finally the consumers.

The study has been done to evaluate the practices along the chain actors, to come up with the recommendation and suggestion to improve the food safety in the chain. To achieve the objective of the research actors and government need to cooperate and take these findings into consideration.

6.2 Recommendations

The research study was conducted in a short time and was dependent on data collection. The chemical and biological risk factors at farms and Natafat need more research by JFDA. In order to determine the pathogenic bacteria and chemical residue levels associated with the broiler meat safety in this chain.

Food safety risks exist in this chain and threaten the health of consumers. So, it needs a contribution among related organizations to reach the acceptable level of food risks.

Therefore, the following recommendations are to produce a safe broiler meat:

At farm level: The recommendation for the Ministry of Agriculture (Poultry Division) is to provide the small broiler farmers with training and extensions services on GHPs. Make this training courses a condition to obtain a farm license. The recommended trainings are about:

- The personal hygienic practices such as clean uniform, long boots, using soap and hand disinfectant.
- The importance of using of footbath disinfectant, appropriate feed storage conditions, the awareness of drug administration and withdrawal period.
- The study recommends the Ministry to regulate the manure disposal by law, such as the farmers need to sell the manure to the fertilizer factories.
- Aware plant farmers on risks of using untreated manure.
- The Ministry of Agriculture needs to regulate the dead birds' disposal and impose the farmers to get rid of them in waste dumps.

At trade/transport: the suggestions are to the Municipality of Amman (Food Safety Committee):

- Traders have to be registered and having licenses to work under Municipality regulations,
- Training them on GHPs, especially on practices of foodborne disease control.

At Natafat: the study recommends the Municipality of Amman (Food Safety Committee):

- To give the Natafat a license to sell a frozen and chilled broiler meat instead of live birds.

- For those who wish to sell live birds, the municipality needs to centralize them in special areas. These areas are far enough from residential houses and are regulated by the municipality law to implement the hygienic practices.
- Increase the public awareness regarding broiler meat safety by using the media (TV and newspaper).
- For broiler waste the study recommends that the municipality collects the Natafat waste at the end of the each day. Or the Natafat sign a contract with pet or fertilizer factories to dispose their waste.

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ANNEX 1.0

1.1 Questionnaire for broiler farmers in the both districts

1 - Farmer Age ……
2 - What is your education background?
a) Never been to school b) Primary c) Secondary d) College

3 - How many broilers do you keep per production cycle?
4 - How many production cycles do you have per year?
5 - How often do you replace your footbath disinfectant?
a) No footbath b) less than 5 days c) 6 - 7days d) more than 7days

6 - Where do you prepare the feed?
a) In farm b) buy ready feed

7 - Do your broiler finisher feed contain cocciodiostat?
a) Yes b) No c) don't know

8- Do you have any problems of pests inside the poultry house?
1) Yes 2) No

If yes. 1. Rodents 2. Flies 3.Wild birds 4.Other pests

9 - Have you been experienced disease problem regarding to chicken health?
1) Yes 2) No

If yes, what type of diseases associated yet in your farm?

10 - What measures do you take to address the symptoms?
a) Consult veterinarian b) treat sick birds by yourself

11 - What types of disease do you vaccinate the chicken?
12- How many times do you give the birds antibiotics during the one cycle of broiler production?
13 - Do you know about the medicine withdrawing period before slaughtering of broiler chicken?
a) Yes b) No

If yes do you implement the medicine withdrawing period?

14 - Do you clean and disinfect the poultry house after each cycle?
15 - Do you have any rule for visitors regarding hygiene?
1) Yes 2) No
If yes, please explain ……..

16 - How do you manage the chickens' manure?
17 - What personal hygienic practices are follow in the farm?
a) Soap and hand disinfectant b) uniform clothes d) long boot

18 - What is the mortality percentage do you have in farm?

a) >5 b) 5-10 d) 10 – 15 c) >15

19- How do you get rid of the dead birds?
20 - Are you aware of the practice of withdrawing feeds before slaughtering of broiler chicken?

a) Yes b) No

If yes, how long is your withdrawal period? .....

1.2 Checklist for the trader:

1- Which time of day do you transport the broiler birds?
2- Do you clean and disinfect the cages and vehicle after used?
3- How much time do the birds stay in vehicles during the transportation?
4- How long the distance between the farm and Natafat?
5- Do you implement the personal hygienic practices when you dealing with birds? If yes what practices are you doing?

1.3 Checklist for Natafat:

1- Person age ……
2- What is your education background?

a) Never been to school b) Primary c) Secondary d) College

3- Do the chicken inspect before or after slaughtering by a veterinarian or an expertise in poultry?

1) Yes 2) No

4- Do you clean and disinfect all the surfaces and facilities before and after slaughtering?

1) Yes 2) No

5- Do you wear clean clothes, head cover and cloves during slaughtering process?

1) Yes 2) No

6- Do you wash your hands with soap after toilet and before enter to slaughtering unit?

1) Yes 2) No

7- Do you know about the basic hygiene practices?

1) Yes 2) No

8- Do you have a Medical health certificate from the government?

1) Yes 2) No

9- What are the requirements of the government?

10- How do you manage the broiler waste?

1.4 Interview with the Amman Municipality officers/ Food Safety Division:

1- What the hygienic issues are required from the Natafat as a regulations or instructions?
2- How many times the Municipality officers check on Natafat?

3- Is there any complain from people on Natafat? If yes, what type of complaint is that?
4- What is the common safety risks associated with Natafat concerning consumers' health?
5- What is your opinion about the performance of Natafat related to the food safety?

1.5 Interview with the Ministry of Agricultural officers:

1- What the hygienic practices regulations are required from the small commercial broiler farmers?
2- What is the common safety risks associated with the small commercial broiler farms can affect on consumers' health?
3- What is your opinion about the performance of small broiler farmers in term of food safety?
4- What do you suggest to improve the food safety in the farm?