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Original Research Article

Current situation assessment of biosecurity measures of some poultry sectors and hatcheries in Egypt

Asmaa N. Mohammed[1,*], Hassan El Sayed Helal[2]

[1]Department of Hygiene, Zoonoses and Epidemiology, Faculty of Veterinary Medicine, Beni-Suef University, Beni-Suef 62511, Egypt.
[2]Consultant of Poultry Diseases, postgraduate student (MVSC) in Department of Poultry Diseases, Faculty of Veterinary Medicine, Beni-Suef University, Beni-Suef 62511, Egypt.

ABSTRACT

Preventing the transmission of disease into and between poultry farms, hatcheries, and from wildlife, or their droppings, is essential to maintain healthy productive poultry flocks. This study was designed to assess the current situation of biosecurity measures in 3 types of poultry operations; 125 small-scale commercial broiler farms (sector III), hobby poultry premises (backyards; sector IV) and hatcheries selected from Giza, Fayoum and Beni-Suef province, Egypt. A structured questionnaire survey, interviews and observation were used to collect data on farm characterization, bio-security practices and disease preventive measures in sectors and hatcheries. The respondents were farm owners, farm managers, veterinarians, and workers. It has been found that the distance between small commercial broiler farms were 48.4% [2- 5 km] while for hobby poultry keepers 66.5% [≤100 m], and hatcheries 41.6% [1-3 km] and 30.6% [7-11 km]. In small-scale broiler farms practiced all in/ all out system (89 %) as compared to hatcheries and backyards (83.3 and 46.1 %, respectively). In the most of the small commercial broiler farms, the resting period between production cycles was higher on 4-7 days (32.5%). Methods most used for disposal of daily mortalities were on landfill (45.2%) among small commercial broiler farms. Meanwhile, hobby poultry premises and hatcheries included disposal in water canals (38.5 and 33.3%, respectively). On the other hand, Hobby poultry keepers reported that veterinarians rarely inspected their premises. Mortality rate/cycle was (11.9%) in almost broiler farms. About 64.3 % of the small commercial producers practiced all the recommended vaccination of their birds against highly pathogenic diseases. In conclusion, the majority of the small-scale broiler farms and all most backyards were far from the implementation of biosecurity measures. Biosecurity situation needs a combined effort from stakeholders, poultry keeper of hobby birds (backyard) to improve biosecurity level for those sectors.

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*Corresponding author: Asmaa N. Mohammed; Department of Hygiene, Zoonoses and Epidemiology, Faculty of Veterinary Medicine, Beni-Suef University, Beni-Suef 62511, Egypt. E-mail: asmaa.mohamed2@vet.bsu.edu.eg

1. Introduction

Biosecurity practices are an important component of modern flock health programs that designed to minimize the transmission of infectious diseases between and within farms (Dorea et al., 2010). Poultry sectors characterized by a huge diversity of production with different scales, bird species, biosecurity measures, production inputs, and outputs. Both intensive production systems and hobby poultry sites (smallholder) coexist, with very different characteristics. Meanwhile, the scope and impact of biosecurity measures may be obvious for large poultry production systems however; its significance for small poultry-breeders should not be overlooked (Van Steenwinkel et al., 2011).

Poultry production represents an important sector in animal production, with small commercial and backyard systems that are often extensive dominating the industry especially in the developing countries (Conan et al., 2012). Poultry sites classification, based on the risk for disease spread and introduction are important factor in the development of risk surveillance, and recommendations for producers, as well as for modeling purposes (Lyytikainen and Kallio, 2008; Ortiz-Pelaez and Pfeiffer, 2008; Niemi et al., 2009) . The main components of biosecurity are isolation, cleaning then disinfection (FAO, 2008). These divided into three categories; conceptual, including the location of farms; structural, covering the building design and facilities to protect against entry of wild birds and predators; operational, covering the routine disinfection, sanitation and work procedures, those farmers and visitors adopt (Shane, 1997). Moreover, sanitation is an important component of biosecurity to reduce the likelihood of potential introducing and spreading of disease-causing organisms onto and between farms (Charles and AyodeleAdekunle, 2004).

Biosecurity implementation requires experience throughout awareness, training, known the resources of higher risk loss of profit (Conan et al., 2012). Moreover, a serious risk of infection spread with using of untreated poultry manure as fertilizer (Cristalli and Capua, 2007). Water and feed sources recognized as a biosecurity hazard to poultry (Njue, 2009). Fasina et al. (2012) assessed the correlation between untreated water source used and outbreaks of HPAI A/H5N1 for birds and pointed to the producers in developing countries use raw water from rivers or ponds for their birds. In spite of the importance of biosecurity practices, there is little information available in the literature on the biosecurity status of poultry farms (Nespeca et al., 1997; East et al., 2007). Several papers have used multivariate analyses to classify these farms (Calavas et al., 1998; Solano et al., 2000; Rose and Madec, 2002; Kobrich et al., 2003; Kristensen, 2003; Boklund et al., 2004; Milan et al., 2006; Ribbens et al., 2008; Costard et al., 2009). However, to the author's knowledge there is not a research paper divided poultry production sectors according to their biosecurity practices yet.

The objective of this study was to assess and describe the currently applied biosecurity measures in small commercial broiler farms (sector III), hoppy poultry premises (backyards; sector IV) and hatcheries in three study provinces, Egypt to improve biosecurity levels throughout a design model for controlling a highly pathogenic disease outbreak in poultry system as a standard. Therefore, an epidemiological approach towards the investigation of the biosecurity level required for highly pathogenic disease outbreaks pursued. The output from this study will be interpreted as a nucleus for risk-analysis in correlation to disease introduction on poultry farms.

2. Material and methods

2.1. Study location and period

This study was conducted on three types of poultry operations throughout a period between November 2015 and May 2016 in the investigated areas [Giza (coordinates: 29°26′N 29°67′E), Fayoum (coordinates: 29°308374′N–30°844105′E) and Beni-Suef (coordinates: 29°04′N 31°05′E) province, Egypt] (Fig. 1).

2.2. Selection of poultry farms

The target population for this study comprised small commercial broiler farms (Sector III), hobby poultry premises (backyard; Sector IV) and hatcheries. For backyard poultry sites ($n \leq 150$ birds) no official database exists meanwhile, in small-scale broiler poultry farms ($n \leq 20000$ birds). However, in Egypt (smallest administrative units) were asked about precautionary measures taken due to the potential highly pathogenic avian influenza (HPAI) threat and identify all inhabitants that kept hobby birds. A stratified proportional allocation was performed to ensure a good representation of the major animal species (chicken, duck, and pigeon), types of operations (top roof breeding, hobby birds, layer hens, broilers, and hatcheries) and geographical distribution.

2.3. Study design

A cross-sectional study was carried out in three types of poultry operations. A structured questionnaire survey was assembled to collect data on farm characterization, bio-security measures, poultry health practices and risk indicators in each operation; small commercial broiler farms (sector III), hobby poultry premises (backyards; sector IV) and hatcheries. At the farm level, risk indicators differentiated in factors related to a location of the farm, management practices and disease preventive measures.

2.4. Questionnaire survey

This questionnaire allowed for the data collection and statistically studied under the condition that they are homogeneous in time and space (Table 2). The questionnaire was divided into four parts and included both standardized closed and semi-closed questions, in total consisting of four pages (52 questions) with regard to the fields. a) farm characterization (location of the farm, type of farm, capacity, bird species, presence of other animals), b) infrastructure (distance in between farms, presence of farm fences, footbath dips, sanitation station and housing secure against wild birds), c) farm management &hygiene (Storage of poultry feed, litter, and manure management, workers, record keeping, isolation of new/sick birds in separate area, sharing machinery, availability of biosecurity plan), d) poultry health practices (pest control، carcasses disposal option, veterinary consultation , disinfection in between cycle, prophylactic treatment and vaccination) which can be attributed to the three categories "farm characterization", "biosecurity practices" and "disease preventive measures".

2.5. Data processing and analysis

All data collected was coded numerically to assist analysis, entered into a database worksheet (Microsoft Excel, 2013) and recoded into categorical data (nominal and ordinal level) for further analysis. Variables that assumed to have a similar influence on the potential risk of introduction of contagious disease on the farm combined into a single variable, by producing a basic biosecurity score as a method described previously by Van Steenwinkel et al., (2011). To this end, all variables were coded using values of one (biosecurity measure present) or zero (absent). All variables divided into Groups, each expressing a different aspect of farm biosecurity. Statistical analyses were performed by the use of non-parametric tests (chi-squared test, and Friedman test and K independent sample) using Statistical Package for Social Sciences (SPSS, version 22). The accepted significance level was $P<0.05$.

3. Results

Survey response

Out of the 125 selected poultry operations; small commercial broiler farms (n= 60), hobby poultry premises (n= 40) and hatcheries (n= 25) (Table 1) in responses were received from (80; 64%) of them but only (n= 45; 36%) questionnaires forms were not completed. For small commercial broiler farms, 70% (42/60) response rate was obtained. The questionnaires for hobby poultry premises were 40 of which 57.5% (26/40) responded. Meanwhile, the hatcheries response rate was 48% (12/25) at X2=9.0, ($P\leq0.05$). All study areas were geographically represented (Fig. 1).

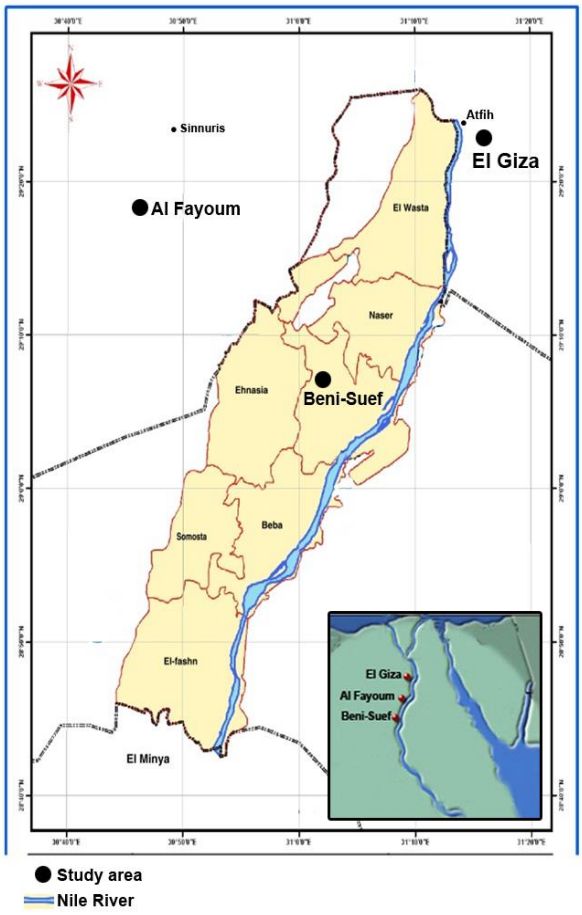

Fig. 1. Location map of study areas in Egypt.

Table 1. Response rates for biosecurity survey distributed to three types of poultry operations in the studied areas.

Survey No.	Poultry operations			Total
	Small commercial broiler farms	Hobby poultry premises	Hatcheries	
Distributed	60	40	25	125
Returned	42	26	12	80
Response rate (%)	70.0	7.5	48.0	64.0

$X^2 = 9.0$, at ($P \leq 0.05$)

Farm characterization and infrastructure

Based on filed observations, quantitative data was collected through structured interviews were used to gather information on conceptual, Structural and operational biosecurity (Table 2). Questionnaires administered face-to-face by two veterinarians have the ability to access the farmers and stockholders. Conceptual biosecurity data are the location of farms and layout of a production area, capacity, and the distance between farms, and the presence of fence around premises. Furthermore, extra movements occurred resulting from farm visits by visitors, veterinarians, feed and litter suppliers, vaccinators, manure removal trucks, cleaning and disinfection equipment, dead bird disposal were revised.

Poultry management and hygiene

An interval of up to 15 days between production cycles usually allowed. The availability for proper isolation of sick birds away from healthy one in separate areas was difficult especially in hobby poultry flocks. Common methods for the disposal of dead birds in small-scale broiler production were landfill and burial. Meanwhile, in hobby poultry premises included throwing them into watercourses or in roads making them available for scavenge by stray dogs and cats (Table 2).

Diseases preventive measures

For pest control, most producers had installed wire mesh on windows as, insects, rodents did not perceive as a major threat in transmitting disease, thus, insecticides, and rodent baits rarely used especially in hobby poultry premises (Table 2). Some of the small commercial broiler farms might allocate especial attendants provide with special clothing/footwear for each poultry shed. However, the almost of poultry producers usually used the same clothes to enter all poultry sheds. Meanwhile, hobby poultry premises did not provide with especial clothing/footwear. Most broiler farms reported using plastic footbath dip. If present, cement footbath dip poorly maintained and inappropriately located for regular use.

Cleaning and disinfection of poultry housing and equipment

Most poultry farmers reported that after each production cycle, proper dry and wet cleaning of poultry sheds followed by disinfection performed. Quaternary ammonium compounds (QUATS), iodine, virkon®S, formalin and phenol-based products were the most commonly used disinfectants, followed by lime. Litter of small commercial broiler farms removed in baskets and emptied in trucks after each production cycle. Generally, poultry producers have especial equipment such as drinkers, feeders, and hauling crates. However, a few participants have high-pressure washers for vehicle and equipment cleaning and disinfection (Table 2). The majority of small commercial farms respondents routinely consulted veterinarians so it reported the lowest percentage of parasitic infestation and respiratory affection as compared to hobby poultry flocks. The mortality rate/ cycle was recorded in the questionnaire and vaccination against highly infectious diseases in addition to HPAI.

Table 2. Summary of the structured questionnaire survey distributed to the three poultry operations in Egypt, to characterize the on-farm implementation of biosecurity measures.

Categories	Survey items
• **Farm characterization**	- District. - Type of farm - Capacity - Type of bird species - Presence of other animals - Number of birds reared /cycle -Cycle duration
• **Biosecurity practices** **-Infrastructure**	- Distance in between farms/or hatcheries. - Presence of fence around premises - Visitors access to poultry sheds and contact with poultry - Shed lock/ gate presence.
-Farm management & hygienic measures	- Utilization of footbath dip at entry gate. - Maintenance of windows mesh and surrounding. - Manure and litter management. - Storage of poultry feed. - Time interval for total sell out. - Availability of biosecurity plan - Removal of dead bird - Carcasses disposal option. - Type of drinking water source. - Hand hygiene before and after handling poultry - Utilization of on farm cloths and footwear. -Cleaning and disinfection of foot wear before and after visits. -Cleaning and disinfection of equipment's &vehicles. - Utilization of high pressure sprayers - Record keeping - Isolation of new/sick birds in separated area.
-Disease preventive measures	- Control of animals and wild birds - Pest control(Rodents and insects) - Veterinary consultation - Disinfection in between cycle - Workers contact with other flock - Prophylactic treatment -Percentages of parasitic infestation and respiratory affection - Mortality rate/ cycle. - Vaccination

Response for biosecurity survey

The survey captured feedback on biosecurity measures from the respondents across three types of poultry operations; in the present study, hobby poultry flocks kept highly susceptible bird species for HPAI as compared to small commercial broiler farms. In contrast, hatcheries did not considered susceptible. The possibility of newly hatched chick indirectly infected through environmental contamination in the hatcheries was ignored. The percentage of three types of poultry operations that implementing different types of biosecurity measures shows in (Table 3); the distance between broiler farms were 34.7% [≤1 km], 48.4% [2-5 km] and 16.9% [≤ 10 km] while, for hobby poultry keepers 66.5% [≤100 m], 33.5% [200-400 m] and hatcheries 41.6% [1-3 km], 27.8% [4-6 km] and 30.6% [7-11 km]. Twenty-two small commercial broiler poultry farms (52.4%) reported that they had fenced off poultry areas in order to isolate their premises for disease control (Table 3). A high percentage of producers (100%; n = 80) reported that they always kept farm premises locked with a controlled entry gate. Generally, 28.6% of small commercial producer allowed visitors to enter poultry sheds (28.6%); however, 57.7 % in hobby bird premises and 33.3% in hatcheries. Furthermore, there was no record keeping of visitor entries.

The small commercial poultry producers clarified that there were sanitation stations at their entry gates (47.6%) while at hobby poultry premises (3.8%) and the nearly most of hatcheries (66.7%). The poultry producers, hatcheries workers and hobby poultry keepers pointed that they sometimes washed their hands before and after handling poultry (33.3, 33.3 and 11.5%, respectively) in addition, both small scale broiler farms and hatcheries producers reported using specific on- farm clothing and footwear (23.8% and 50.0%, respectively). Concerning cleaning and disinfection of housing and equipment, 59.5% of broiler farms, 58.3% hatcheries and 19.2% of hobby bird flocks revealed their cleaning poultry sheds and different equipment's used such as drinkers, feeders, crates were cleaned and disinfected and they didn't use high-pressure sprayers and only one small commercial producer reported clean and disinfect vehicles. Other growers notified that they do not consider vehicles cleaning and disinfection as a tool for disease transmission.

Concerning the time interval for total sell out the birds (Table 3), almost of small commercial broiler farms and hatcheries were (89.0 and 83.3%, respectively) on first 24 h to three days while in the hobby bird flocks was (46.1%). The methods most used for disposal of daily mortalities were on landfill especially among small commercial broiler farms (45.2%); Disposal in water canals (21.4%); Burial (16.6%). Meanwhile hobby bird premises, disposal in water canals (38.5%); throwing for dogs and cats (23.1%) and disposal landfill (19.2%) as compared to hatcheries whereas (33.3%) disposal in water canal and (25.0%) incineration.

For pest control, poultry producers reported to use the secure wire netting on windows to protect the sheds from predators and pest birds. Furthermore, 42.8% of small commercial broiler farms, 25.0% of hatcheries and 19.2% of hobby poultry premises used traps or rodenticide baits to catch rodents and 4.8 % of all producers reported using insecticides. 61.9% of small commercial broiler farms and 33.3 % of hatcheries routinely consulted veterinarian. Hobby poultry keepers reported that their premises rarely inspected by veterinarians and most commonly, farmers visited the veterinary clinics to treat the diseased birds. Disinfection in between cycles were not available in hobby poultry premises. On the other hand, 88.1% among small commercial broiler farms and 83.3% of hatcheries applied. 4.8% of farms and 8.3% of hatcheries had a written protocol related to hygienic measures and operational procedures (Table 3). Mortality rates reported by the poultry producers were significantly greater in hobby poultry premises at $P\leq$ 0.001 (15.4%), in hatcheries (16.7%) than small commercial broiler farms (11.9%). About 64.3 % of the small commercial producers practiced all the recommended vaccination of susceptible birds against Newcastle Disease (ND), Infectious Bursal Disease (IBD), Fowl Cholera, highly pathogenic avian Influenza (HPAI) and Fowl pox.

The time interval between production cycles found to be associated with the different production type (Table 4). In the most of small commercial broiler farms, the resting time between cycles was higher on 4-7 days (32.5%) than on 21≤ days (2.5%) meanwhile, in hobby poultry premises was (25.4%) on 7-10 days and (7.9%) on 0-3 days at X2 = 14.22, (P≤0.001). Furthermore, in hatcheries, the downtime between production cycles was reached (26.4%) on 11-15 days and (11.4%) on 21≤ days. On the other hand, it has been found that small commercial farmers (23.8 %) and hobby poultry premises (3.8%) only isolate a new/ sick birds in separated area away from their flocks during production cycle (Table 3), increasing the risk of introducing HPAI and other infectious diseases.

4. Discussion

This study assessed the current situation and implementation of biosecurity measures among three types of poultry operations; small commercial broiler farms, backyards and hatcheries by using structured questionnaire, interviews and field observations. The obtained results clarified that the response rates of questionnaire received from (80; 64%) of three types of poultry operations, whereas small commercial broiler farms (70%), hobby poultry premises (57.5%) and hatcheries (48.0%) exceed other similar surveys (Fiebig et al., 2009). Moreover, Van Steenwinkel et al. (2011) found that the response rate of professional poultry farms was (61.5%), hatcheries (59.4%) and hobby poultry keepers (19.6%) was low, which was attributed that many participants encountered difficulties to connect to the internet site in Belgium.

Small commercial broiler farms and hobby poultry premises in the present study are located near each other. Similar results in Switzerland reported the contact between professional and hoppy poultry farms and found that, there were high-density areas with more eight poultry sites/km2 (Fiebig et al., 2009). On the other hand, 52.4% of small commercial broiler farms reported that they isolate their premises using fence around poultry house for disease control as compared to 38.5% hoppy poultry flocks. Maduka et al. (2016) showed the positive responses were (80–90%) to biosecurity practices such as, gate provided with fence, practice of all-in all-out management and frequent changing of bedding. In the present study, small commercial producer allowed visitors to enter poultry sheds (28.6%), hobby poultry premises and hatcheries (57.7% and 33.3%, respectively). Mustafa, (2013) pointed to the first line of defense against disease transmission are a fence and a closed gate and showed that farm fence was not available for most farms in both semi modern and traditional systems. Meanwhile, Dorea et al. (2010) stated that visitor's access does not usually prevented into premises or asked to wash car tires before entering the farm. Furthermore, Maduka et al. (2016) clarified that some farmers (47.4%) allowed visitors into the poultry premises.

Biosecurity levels in three types of poultry operations were not surprising in this study. There were no facilities available for proper segregation of diseased birds in separated areas. Furthermore, most producers reported that they isolated the diseased birds in a designated area through the same house as the rest of the flock. Sanitation stations were rarely present especially in hobby poultry premises and there were not biosecurity plans implemented on-farm. Furthermore, survey results of Tabidi et al. (2014) indicated that poultry growers in semi modern and traditional systems were adapted low frequency of biosecurity measures ($P \leq 0.01$) compared to modern production system. Moreover, Boklund et al. (2004) stated that smaller conventional sites are not motivated to implement disease preventive measures because the costs would be relatively small when anew pathogen introduced. On the other hand, Haftom et al. (2015) showed that 80% of the broiler farms used a footbath at the gate and 88% of the farms were practicing cleaning and disinfection of house and equipment. Sudarnika et al. (2010) found that 24 farmers (96%) separated sick birds from healthy birds and burned or buried them for disposable and just two farms (4.4%) left dead birds thrown away.

The survey results and data collected through direct observation indicated that poultry keepers have some basic information of biosecurity measures but there is a significant gap between their knowledge of biosecurity and its implementation. Similarly, another study reported differences between biosecurity knowledge and actions among backyard poultry breeders of Fayoum province, Egypt (Radwan et al., 2011; Negro-Calduch et al., 2013). However, biosecurity at the farm level provides the principles for biosecurity practices of the production chain (Siekkinen et al., 2012).

Disposal of dead birds in each poultry operation reported and Participants clarified lack of resources and sufficient space for implementing disposal measures such as burning or burial. Most farm attendants admitted for neglecting hand washing, even after handling daily mortalities. Furthermore, producers did not apply the composting as a secure method to dispose of dead poultry. Furthermore, disposal of hobby poultry and hatcheries carcasses into watercourses and on road for scavenge to dogs contributing to the risk of environmental pollution and enhancement of diseases transmission. US EPA (2006) pointed that on site compositing has been shown to be successful practice based on its effectiveness by inactivating the H5N1 virus.

Table 3. Response to the structured questionnaire on implementation of biosecurity practices.

Categories	Biosecurity practices	COMM (*n*= 42)	HOB (*n*= 26)	HAT (*n*= 12)	*P*-value
Infrastructure	-Suitable distance in between farms/ or hatcheries.	27 (64.2%)	8 (30.8%)	7 (58.3%)	0.00
	-Presence of fence around premises	22 (52.4%)	10 (38.5%)	/	0.01
	-Visitors access to poultry compartments	12 (28.6%)	15 (57.7%)	4 (33.3%)	0.00
	-Shed lock/ gate presence.	42 (100%)	26 (100%)	12 (100%)	
Farm management and hygienic measures	-Presence of sanitation station (footbath dip at entry gate)	20 (47.6%)	1(3.8%)	8 (66.7%)	0.033
	- Hand hygiene before and after handling poultry	14 (33.3%)	3 (11.5%)	4 (33.3%)	0.05
	-Utilization of on farm cloths and footwear.	10 (23.8%)	0 (0.0 %)	6 (50.0%)	0.02
	-Cleaning and disinfection of equipment's &vehicles.	25 (59.5%)	5 (19.2%)	7 (58.3%)	0.042
	- Proper cleaning and disinfection of egg containers	/	/	5 (41.7%)	-
	-Isolation of new/sick birds in separated area.	10 (23.8%)	1 (3.8%)	/	0.001
	-Availability of written biosecurity plan	2 (4.8%)	0 (0.0%)	1 (8.3%)	0.003
	-Time interval for total sell out				
	. 24hr-3 days	37 (89.0%)	12 (46.1%)	10(83.3%)	0.05
	. 5 days or more	5 (11.9%)	14 (53.8%)	2 (16.7%)	0.001
	- Carcasses disposal option				
	. Disposal landfill	19 (45.2%)	5 (19.2%)	1 (8.3%)	0.046
	. Burial	7 (16.7%)	3 (11.5%)	2 (16.7%)	0.871
	. Burning	/	/	1(8.3%)	-
	.Incineration	4 (9.5%)	2 (7.7%)	3(25.0%)	0.543
	. Disposal in water canal	9 (21.4%)	10 (38.5%)	4 (33.3%)	0.021
	. Dogs/ cats feeding	3 (7.1%)	6 (23.1%)	1 (8.3%)	0.05
Disease preventive measures	-Pest control				
	. Utilization of rodenticide/trap	18 (42.8%)	5 (19.2%)	3 (25.0%)	
	. Utilization of insecticides.	2 (4.8%)	2 (7.7%)	/	
	-Veterinary consultation	26 (61.9%)	/	4 (33.3%)	
	-Disinfection in between cycle	37 (88.1%)	/	10(83.3%)	0.0001
	-Disinfection of drinking water	3(7.1%)	/	/	
	-Mortality rate /cycle	5 (11.9%)	4(15.4%)	2(16.7%)	
	-Vaccination	27 (64.3%)	2 (7.7%)	/	

Table 4. Duration of the resting period interval between cycles/type of poultry operation.

Categories	0-3 days	4-6 days	7-10 days	11-15 days	16-20 days	21≤ days
COMM	12.1%	32.5%	29.9%	13.3%	10.5%	2.5%
HOB	7.9%	17.6%	25.4%	20.5%	15.7%	12.8%
HAT	5.5%	14.3%	23.8%	26.4%	18.6%	11.4%

-**COMM**: Small commercial broiler farms; **HOB**: Hobby poultry premises; **HAT**: Hatcheries ; $\mathbf{X^2}$ = 14.22, at ($P \leq 0.001$)

Meanwhile, Dorea et al. (2010) reported that the practice of disposing birds' off-farm might pose a higher risk of pathogen spread. Their statement confirmed by Akey (2003) who reported daily transportation of dead birds to rendering facilities off farm.

For pest control, insecticides and rodent baits rarely used especially in hobby poultry premises as compared to small-scale broiler farms. Concerning, cleaning and disinfection of poultry houses; hobby poultry keepers showed that dry cleaning followed by disinfectants were applied directly without wet cleaning performed. Furthermore, utilization of footbath dip at entry gates of small-scale broiler farm (47.6%) meanwhile, at hobby poultry premises (3.8%) and hatcheries (66.7%). On the other hand, Ali et al. (2014) showed that closed system has a high level of biosecurity than the open system, 84.6% was using disinfectants in the footbath in the front shed entrance and both systems do not share equipment between farms. In this study, small commercial broiler farms, the litter's surface sold as crop fertilizer and the deep layer as feed supplement for fish. Moreover, producers were not gave the importance of cleaning the dirty areas. Furthermore, the cleanliness of drinkers, feeders and crates was clearly poor in both sectors (IV and III, respectively). Meanwhile, in hatcheries, workers used formalin in fumigation for disinfection process. Fasina et al. (2012) illustrated that the implementation of desirable biosecurity for HPIA in back yard production achieved 8.45 benefit-cost ratio. The lack of biosecurity measures implementation leads to low feed conversion rates, poor poultry health and high losses. Improving biosecurity in the small-scale poultry production units of Egypt represents a great challenge in the current situation (Negro-Calduch et al., 2013).

Some pathogens can survive for a long time in the environment without the presence of poultry. Therefore, steps of the complete cleaning and disinfection protocol between two production cycles should be applied (Butcher and Miles, 2012). Turkson and Okike (2016) pointed to the biosecurity practice is critical in efforts to prevent and control HPAI H5N1. Moreover, most of broiler chicken farms were of small scale with low or no biosecurity measures, which increase the likelihood of disease transmission between poultry farms and backyard and increase the risk of human exposure to potential health hazards (Eltholth et al., 2016). In Contrast, Samanta et al. (2015) revealed that the implementation of the biosecurity strategy in backyard poultry farming in West Bengal could substantially benefit the farmers in terms of increased egg production. The small commercial producers practiced all the recommended vaccination of their birds (64.3 %) against the preventable diseases of Newcastle Disease (ND), Infectious Bursal Disease (IBD), Fowl Cholera, HPAI and Fowl pox. These results were nearly similar to Ali et al. (2014) showed that 91.1% of the respondents had a vaccination program according to FAO (2007) regulation. A vaccination regime is available for the broiler flocks in each country and ever for the respective farms that plan a program depending upon the disease challenge in the country.

The downtime between production cycles in three types of poultry operations was up to 15 days' intervals. These results could attributed to the producers aimed at optimizing the period by increasing the number of cycles per years thus reducing downtime between cycles whereas longer downtime periods observed more often among small commercial broiler farms as compared to hobby poultry premises and hatcheries. However, downtime

length depend mostly on the price of day-old-chicks in markets. If the price were attractive, a new production cycle would start regardless of the need for downtime (Negro-Calduch et al., 2013).

5. Conclusion

The majority of the small-scale broiler farms and all most backyards were far from the implementation of biosecurity measures. Many farm workers do not know how to maintain and improve biosecurity to protect their poultry as well as themselves from risk of diseases. Biosecurity current situation needs a combined effort from stakeholders, keepers of hobby birds (backyard) to improve biosecurity levels for those sectors.

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