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Management of Poultry Farms and the Likelihood of Contamination of Poultry Feed with Mycotoxins in Gharbia Governorate, Egypt

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ABSTRACT

The aim of this study was to characterize the poultry production system in Gharbia governorate and assessing the risk of contamination of poultry feed with mycotoxins. A total of 65 poultry farms were visited, in addition to interviewing owners and/or workers, poultry feed samples were collected. Feed samples were analysed for the detection of Total Aflatoxin (TA) and Ochratoxin A (OTA). The concentrations of TA and OTA were determined using direct competitive Enzyme-Linked Immunosorbent Assay. About 50% and 36% of farms were rearing ducks and broiler chickens, respectively. The number of birds per cycle was varied between less than 5,000 to more than 20,000. 58.5% of poultry farms reported having special designated area for dead poultry disposal and 77% of poultry farms used branded commercial feed. The mean length of storage of feed at the farm was five days and about 75% reported having a special poultry feed store. Almost all poultry farmers reported that, they have heard about mycotoxins and more than 80% used anti-mycotoxins as feed additives. All samples were contaminated with both Aflatoxins and Ochratoxins. The mean concentration of Aflatoxins in feed samples was 73.25 ppb, and 100% of samples were higher than the maximum permissible limit (20 ppb). The mean concentration of Ochratoxins in feed samples was 43.58 ppb, and 2.22% of samples were higher than the MPL (100 ppb). In conclusion, the hygienic conditions of the current poultry production system in Gharbia governorate were not optimum. This would increase the likelihood of disease transmission between poultry farms and the likelihood of contamination of poultry feed with mycotoxins. Breeder companies and poultry feed traders could play a role in raising the awareness of poultry producers with the importance of hygiene and biosecurity. Further studies for the economic impacts of mycotoxins on poultry production are required.

Key words: Poultry Farms, Aflatoxins, Ochratoxins, Feed Stores, Hygiene, Management

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INTRODUCTION

Poultry is one of the fastest growing livestock sectors, with an annual growth rate of 21%, providing an additional source of income and an affordable and accessible source of protein to many poor households (Otte et al., 2008). In Egypt, about 70% of broilers are produced by medium to large-scale commercial farms with the remaining 30% produced by small-scale village farms (Kaoud 2007). Gharbia governorate, one of the Nile Delta region, was responsible for 17% of the total broiler production in Egypt and has one of the highest poultry densities in the country (MALR, 2005). Feed supply is an essential component to all animal production systems and any factor that affects the security of the feed supply is a significant constraint to production. One of these factors was the spoilage of feed by fungi that results not only in reducing palatability and the nutritive value but also contaminated feed may become contaminated with toxic secondary fungal metabolites known as mycotoxins (Christensen, 1982; Richard, 2007). The contamination levels of animal feed by mycotoxins were usually not high enough to cause an obvious disease but may result in economic loss through subclinical changes in growth, production and immunosuppression (Hamilton, 1982; Oswald and Taranu, 2008). It was concluded that, mycotoxins not only constitute a significant problem for the animal feed industry but also a risk to feed supply security (Bryden, 2012). In Egypt, poultry industry is highly dependent on imported feed ingredients, which are high likely to be contaminated by fungi either during production stages or during transportation from the producing country to Egypt due to exposure to different environmental conditions. Poultry feed could also be contaminated during storage in the Egyptian markets and poultry farms (Hassan et al., 2012). 500 samples of animal feed and feed ingredients were tested for Aflatoxin B1 (AFB1) and it was found that the level of contamination was 125 ppb, 25-50 ppb, 101-200 ppb and 201-2000 ppb in 19.8%, 9%, 6.4% and 3.8% of samples, respectively (Azab et al., 2005). The level of contamination of poultry feed samples from Ismailia governorate, Egypt with Ochratoxins was found to be ranged from 7.10 to 20.72 ppb (Hassan et al., 2012). In samples collected from the country side, the level of

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contamination of cereals with Ochratoxins was ranged from 18 to 421 ppb (Zohair and Salem, 2006). It was concluded that different levels of contamination may reflect the different hygienic measures and even low level of contamination with Ochratoxins (0.5 to 1.5 ppm) may affect poultry performance. The cell mediated immunity was significantly reduced in chicks fed ration contaminated with Aflatoxin B1 (2 ppm) and OTA (4 ppm) (Nedeljković-Trailović et al., 2004; Verma et al., 2004). Therefore the aim of this study was to investigate the poultry farm management and hygienic conditions in Gharbia governorate, one of the highly poultry producing areas and to assess the likelihood of contamination of poultry feed with mycotoxins particularly Aflatoxins and Ochratoxins. A good understanding of the structure of the poultry production is critical when designing and implementing realistic and effective control strategies for poultry diseases.

MATERIAL AND METHODS

Study area

This study has been carried out in Gharbia governorate located in the centre of the Nile Delta region of Egypt, Figure 1. This Governorate has human population nearly five million, representing 6% of the total human population of Egypt. According to the Ministry of Agriculture and Land Reclamation (MALR, 2006), Gharbia was responsible for 17% of the total broiler production in Egypt and has one of the highest densities of poultry in the country.

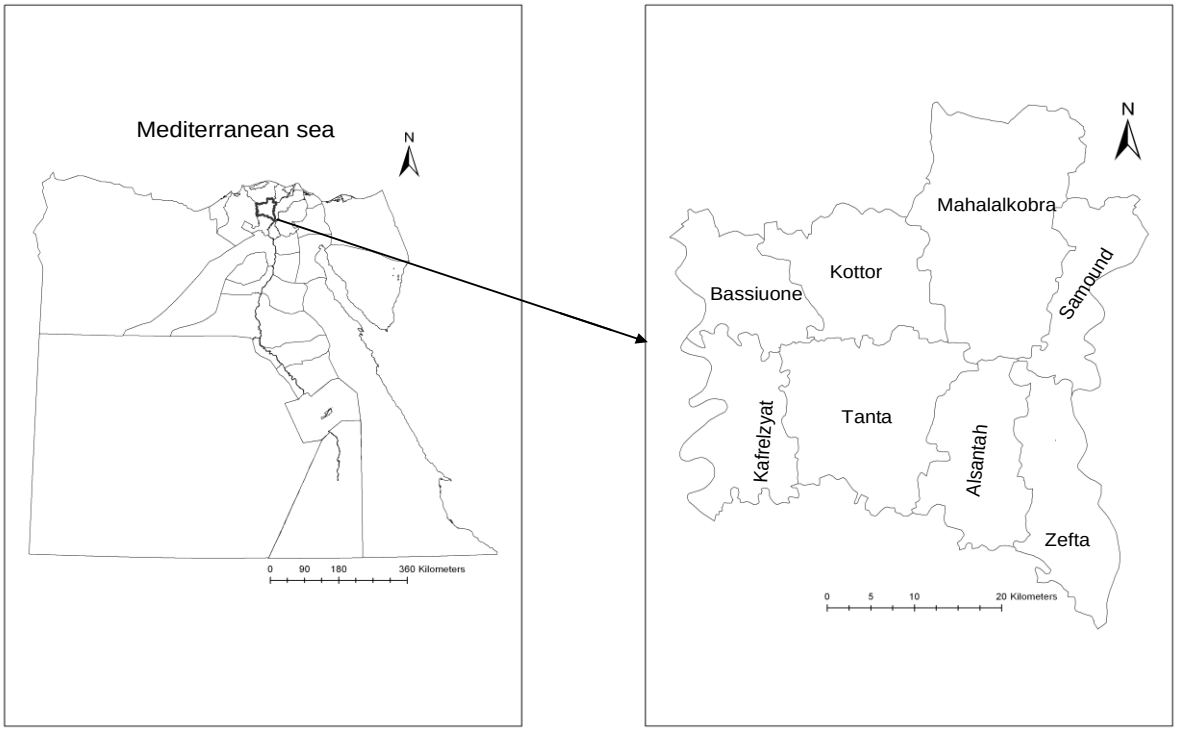

Figure 1. Map of Egypt showing the location of Gharbia governorate and its districts

Data collection

A standardized questionnaire was administered to selected poultry farms. The questionnaire focussed on the production and marketing of poultry, hygienic measures within the poultry farms, interaction with other poultry producers and knowledge about mycotoxins and any control measures were taken. Poultry farm worker/s at the time of the visit was interviewed. Apart from carrying out the interviews, interviewer (the first author) was asked to register her views and take photos when possible. The questionnaire was developed in English and latter translated to Arabic by two Egyptian Arabic native speakers. The questionnaire was piloted and necessary changes were introduced following the piloting. Before each visit, the village's official veterinarian was contacted and asked to collaborate in the identification of poultry farms in the area. In addition to poultry farms, poultry feed stores were visited to identify sources of feed and the hygienic conditions of poultry feed storage. Beside interviews, 250 gm of poultry feed samples were collected from each farm in sterile containers and identified with a unique code for each farm and transferred directly to the laboratory, Central Diagnostic and Research Laboratory, Faculty of Veterinary Medicine, Kafrelsheikh University, Kafrelsheikh, Egypt. This survey was conducted between July 2013 and October 2014.

Laboratory analysis

Feed samples collected from poultry farms were prepared and tested for the presence and concentration of total Aflatoxins and Ochratoxins. The diagnostic kits used for laboratory analyses were Ridascreen fast Aflatoxin (R-

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Biopharm AG, Germany), enzyme immunoassay for quantitative analysis of Aflatoxin in cereals and feed, and Ridascreen fast Ochratoxin A (R-Biopharm AG, Germany), competitive enzyme immunoassay for the quantitative analysis of Ochratoxinin cereal, using BIORAD ELIZA reader. The limit of detection was 5 ppb and 2 ppb for Ochratoxins and Aflatoxins, respectively. Preparation, extraction and measurement were conducted as per manufacturer instructions.

Data management and statistical analysis

Data collected were translated back to English. Statistical analyses were conducted to allow comparison between different poultry farm characteristics using IBM SPSS Statistics for Windows, Version 19.0 Armonk, NY: IBM Corp. Descriptive statistics were obtained for the key variables from the questionnaire.

RESULTS

Survey results

Sixty five poultry farms from Gharbia governorate were visited. Demographic characteristics of poultry farm owners were summarised in Table 1. Almost all poultry farm workers/owners were males. The mean age was 36 years and more than 60% were none educated. About 50% and 36% of farms were rearing duck and broiler chicken, respectively. The number of birds per cycle was varied between less than 5,000 to more than 20,000, characteristics of poultry farm production were summarised in Table 2. Almost all farms used deep litter system and a few proportion (11%) reported using automatic feeders. Regarding the hygienic disposal of dead poultry, 58.5% reported having special designated area for dead poultry disposal. About 22% have household poultry. About 77% and 31% of poultry farms used branded commercial feed and home-made feed, respectively. The mean amount of branded-commercial feed per cycle was 11 tonne. For those who mix feed at the farm level, the most common ingredient used were corn, soya, bran, mineral mixture, vitamin and concentrate. The mean length of storage of feed at the farm was 15 days and about 75% reported using a special store for poultry feed at the farm. The main source of water was public water supply (60%) however about 30% of farms used ground water. Almost all poultry farmers reported that they have heard about mycotoxins and they believe that it is harmful for poultry. More than 80% of poultry farmers used anti-mycotoxins feed additives such as synertox either in water or mixed with feed to control mycotoxins.

There were different sources from which poultry farmers can get young chicks such as breeder companies, traditional hatcheries, their own breeder farms and poultry middle men (Figure2). Poultry farmers sold their poultry to different buyers but most commonly to the wholesalers (40%), (Figure3). More than 90% of poultry producers used poultry manure as fertilizers and high proportion, 25% used dead poultry as feed for dogs, respectively (Figure4 and 5). Interviewer's observations for poultry farms were summarised in Figure 5. It was noticeable that, foot path and/or dip were found in 19% of farms however signs of use were observed in less than 19% of poultry farms (Figure 6). Poultry feed was found to be stored in the same place with poultry in about 7% of farms and there was not specified area for hygienic disposal of dead poultry in about 60% of poultry farms.

Laboratory Results

Results from laboratory analysis were summarised in Table 3. The mean concentration of Aflatoxins in feed samples was 73.25 ppb, and 100% of samples were higher than the MPL established by the European Commission (20 µ/kg). The mean concentration of Ochratoxins in feed samples was 43.58 ppb and 2.22% of samples were higher than the MPL established by the European Union (100 µ/kg).

Table 1. Demographic characteristics of poultry farmers during 2013 and 2014 in Gharbia governorate, Egypt

Characteristics	Interviewee (n=65)
Position in the farm, n (%)	
Owner	35 (53.8)
Worker	40 (40)
Manager	4 (6.2)
Gender, n (%)	
Male	64 (98.5)
Female	1 (1.5)
Age, year	
Minimum	19
Maximum	55
Mean (SD)	36.27 (8.91)
Education, n (%)	
No	31 (64.6)
Medium	12 (25)
High education	5 (10.4)
Missing	17

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Table 2. Characteristics of poultry farms during 2013 and 2014 in Gharbia governorate, Egypt

Characteristics	Poultry farms (n=65)
Species of poultry, n (%)	
Ducks	31 (48.4)
Broiler chickens	23 (35.9)
Laying chickens	10 (15.6)
Number of birds/farm, n (%)	
Less than 5,000	43 (67.2)
From 5,000 to 10,000	18 (28.1)
More than 20,000	3 (4.7)
Production system, n (%)	
Deep letter	64 (98.5)
Battery system	1 (1.5)
Sources of feed, n (%)	
Branded commercial feed	50 (76.9)
Home-made feed	20 (30.77)
Amount of feed, tonne/cycle	
Minimum	1
Maximum	55
Mean (SD)	11.09 (13.19)
Length of storage of feed, days	
Minimum	2
Maximum	150
Mean (SD)	15.12 (30.55)
Water supply, , n (%)	
Public water supply	40 (61.5)
Ground water	19 (29.2)
Both	5 (7.7)

Table 3. Concentration of mycotoxins in poultry feed samples during 2013 and 2014 from Gharbia Governorate, Egypt

Concentration (PPB)*	Aflatoxins	Ochratoxins
Detection limit	2	5
Minimum	57.06	21.77
Maximum	84.48	113.29
Mean (SD)	73.25 (7.28)	43.58 (18.71)
% of positive samples (higher than the detection limit)	100	100
% of samples higher than the MPL**	100	2.22
MPL of mycotoxins in poultry feed	20	100

*PPB=part per billion (µ/kg), **MPL= maximum permissible limit*

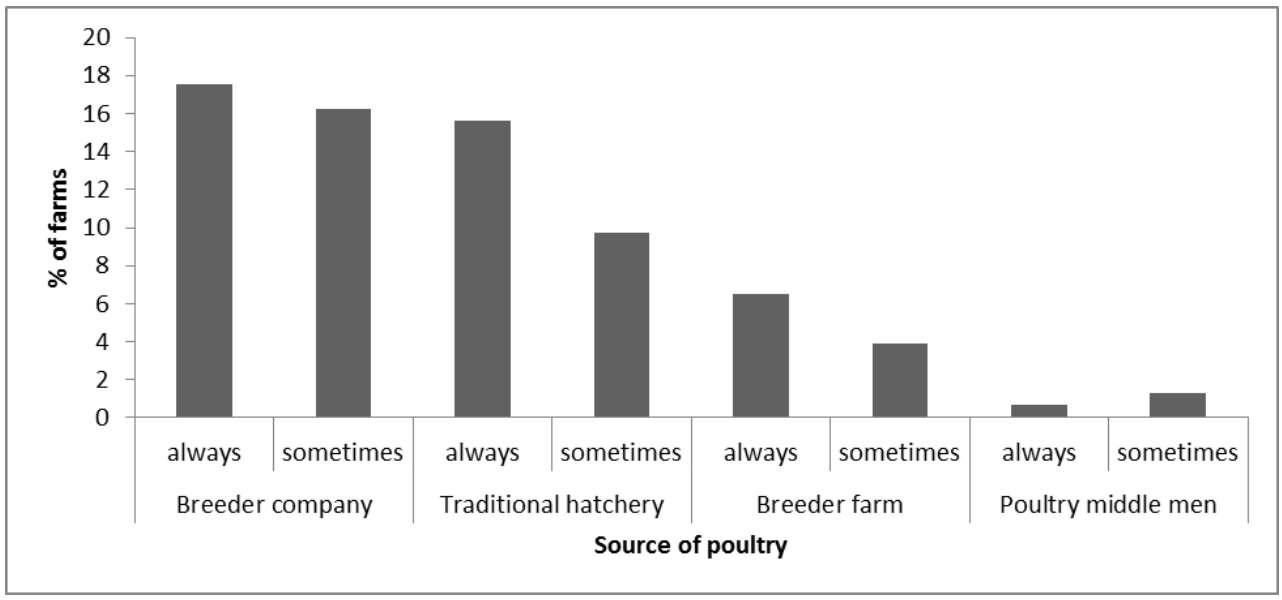

Figure 2. Sources from which poultry farmers bought poultry for their farms during 2013 and 2014in Gharbia Governorate, Egypt

* Mycotoxins in animal feed according to Food Standard Agency: https://www.food.gov.uk/business-industry/farmingfood/crops/mycotoxinsguidance/animalfeed (accessed at 29-7-2015)

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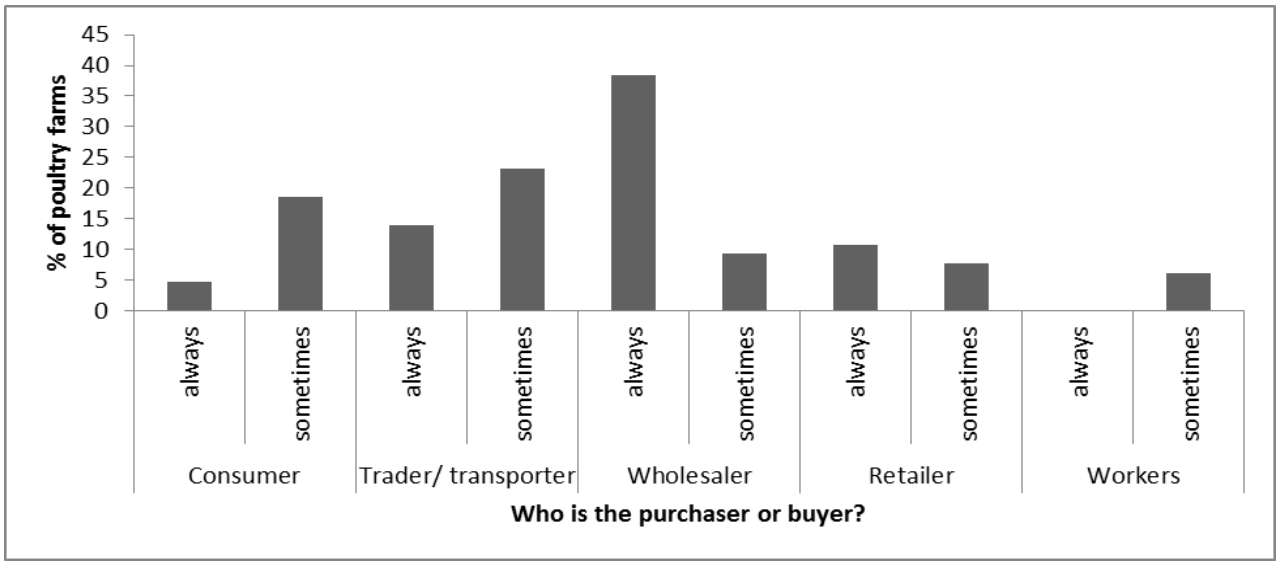

Figure 3. The purchaser of poultry during 2013 and 2014 in Gharbia Governorate, Egypt

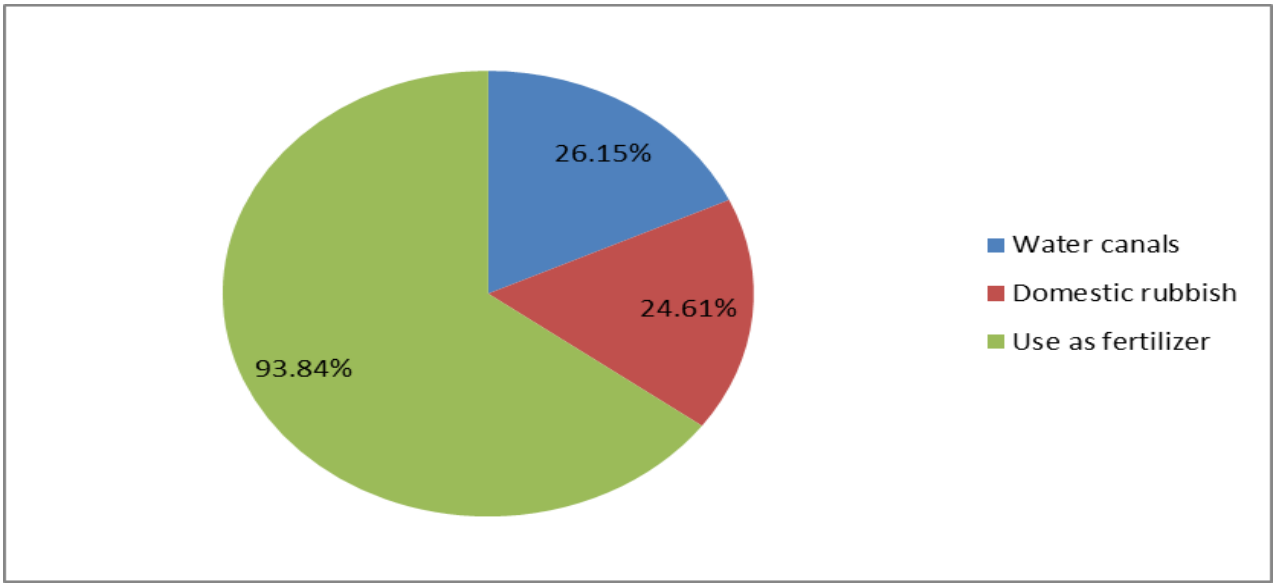

Figure 4. Disposal of poultry manure in poultry farms during 2013 and 2014 in Gharbia Governorate, Egypt

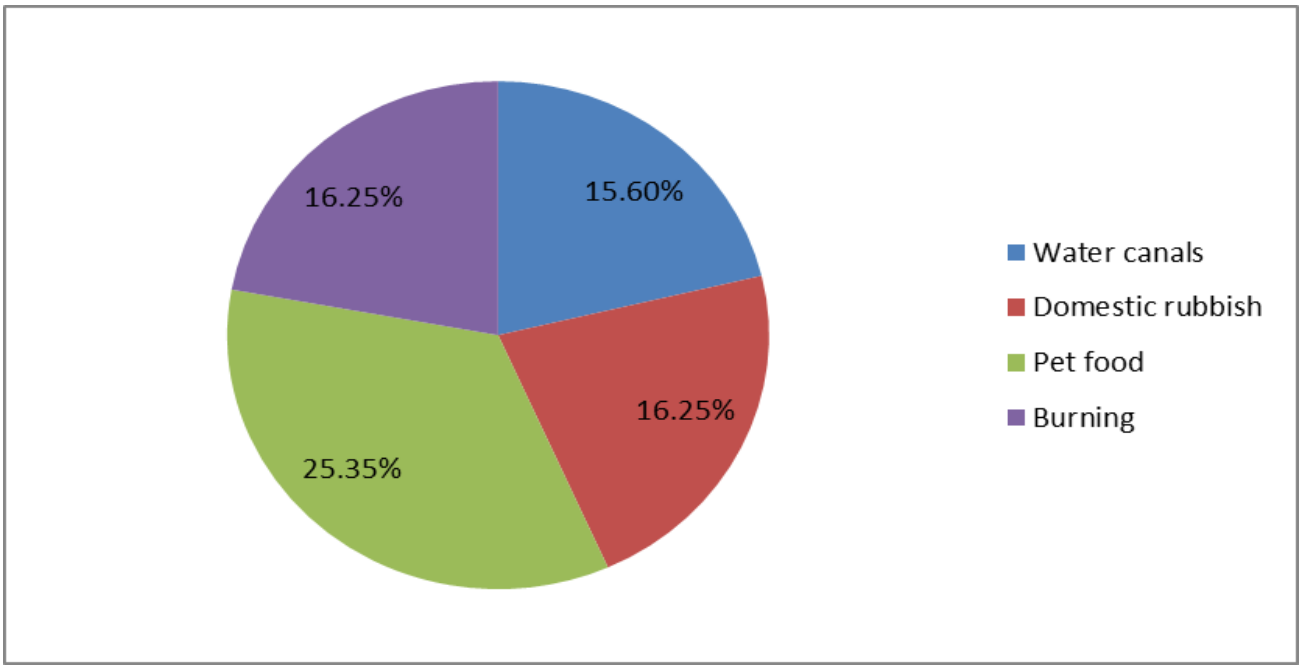

Figure 5. Disposal of dead poultry in poultry farms during 2013 and 2014 in Gharbia Governorate, Egypt

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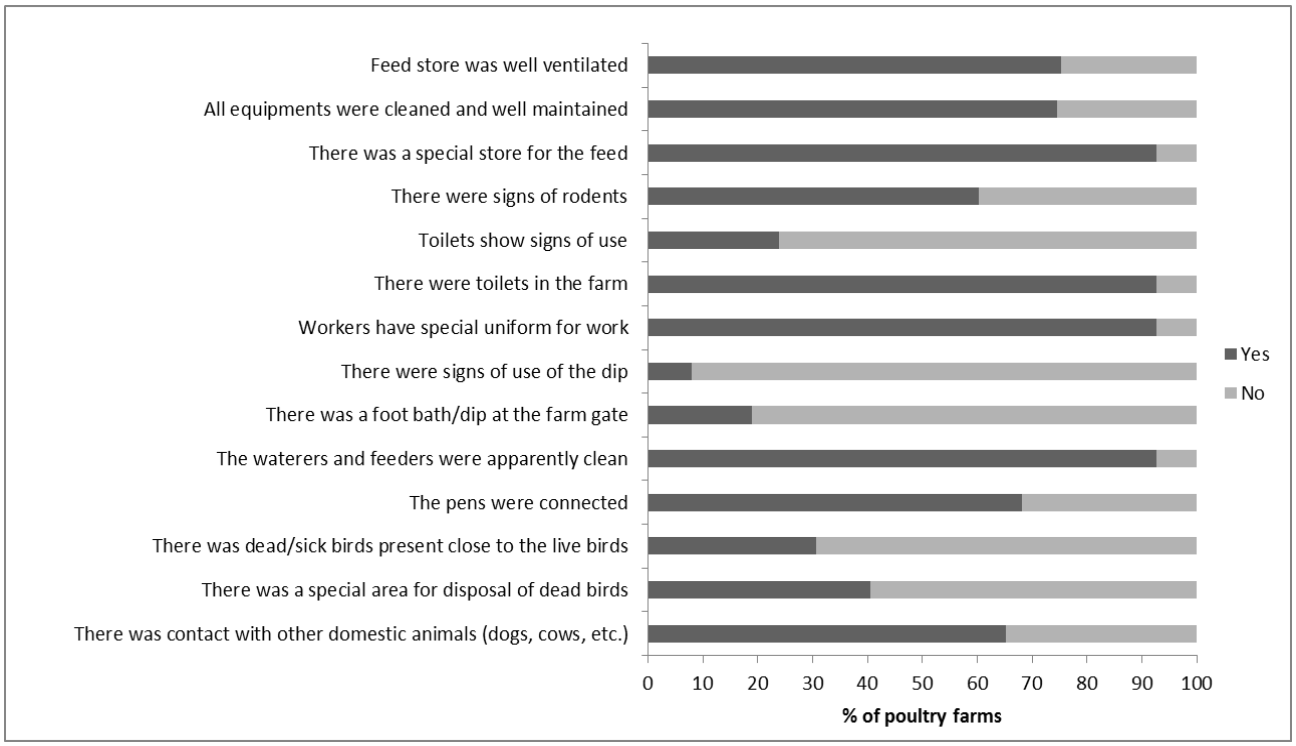

Figure 6. Interviewer's observations for hygienic conditions in poultry farms during 2013 and 2014 in Gharbia Governorate, Egypt

DISCUSSION

An important system of poultry production in Egypt is the poultry farm sector. Results of the present survey indicated that high proportions of poultry farms in the study area are ducks and broiler chicken and the main source of poultry is breeding companies. Poultry breeder companies could be a key point for controlling many poultry diseases and disseminate information to poultry producers. More than 90% of poultry farms used poultry manure as fertilizers which could be a source for many pathogens that can be transmitted to other poultry and/or with potential public health issues. In Indonesia, some HPAI H5N1 cases occurred in people who had no exposure to HPAI H5N1 infected animals, and the source of infection was HPAI H5N1 contaminated poultry manure in the garden fertilizer (Kandun et al., 2010). Therefore, it is important to educate poultry farm workers and others involved in handling poultry manure how to protect themselves and the environment from hazards. Also, as untreated poultry manure can transmit pathogens from endemic area such as Nile Delta to the new reclaimed lands we suggest banning transporting poultry manure from the Nile Delta to the new reclaimed lands. Movement of poultry manure from areas where outbreaks have been reported to other areas and its use as fertilizers should be regulated (Kandun et al., 2010). A considerable proportion of poultry owners threw dead poultry and poultry manure into water canals. This could be a potential source of water contamination with poultry pathogens and consequently transmit these pathogens to other places if water has not been efficiently treated before its use. A high proportion also threw dead poultry and poultry manure into domestic rubbish, consequently unhygienic handling of domestic rubbish by rubbish collectors and handlers could be a risk for potential exposure to zoonotic pathogens. Stray dogs and cats, commonly eat from domestic rubbish and consequently can mechanically transmit pathogens between poultry farms. High proportion of poultry farms were not applying hygienic measures such as having foot path and/or dip on the farm gate. Poultry feed was found to be stored in the same area with poultry in some farms, which increase the likelihood of contamination with mycotoxins due to high humidity. In most of farms there was not specified area for hygienic disposal of sick and/or dead birds which increase the likelihood of spread of poultry diseases to the neighbour farms and/or household poultry. This behaviour of farm owners and workers may be due to either lack of knowledge or carelessness. It could be also a reason for diseases such as HPAI H5N1 to become endemic in Egypt. Policy makers, particularly veterinary services authorities, should work on farmers' knowledge and attitudes in order to increase the efficacy of control measures.

The results for Aflatoxins and Ochratoxins in poultry feed reflected the unhygienic storage conditions of poultry feed in poultry farms in the study area. It was reported that, environmental and poor storage conditions were major causes of mycotoxins contamination of feed and the high levels of Aflatoxins that was capable of posing health hazards. It was also found that, warmer weather, heat waves, greater precipitation and drought had various impacts, increased

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mycotoxins and UV radiation may cause fungi to mutate on crops and produce different mycotoxins (Gwary et al., 2012; Paterson and Lima, 2011).

The level of contamination with Aflatoxins was higher than the MPL by the EU (20 ppb). Our results for Aflatoxins were in agreement with that by (Fareed et al., 2014) who found that 100% of corn samples were contaminated with Aflatoxins with an average contamination level of 80 ppb and a maximum level of 110 ppb. Compared to other ingredients, corn is more susceptible for Aflatoxins production throughout the world (Firdous 2003). In poultry feed in Egypt, the most commonly ingredient is corn.

The present study indicated that Ochratoxins were detected in all samples but only 2% of samples were higher than the MPL by EU (100 ppb). In Pakistan, the overall incidence of Ochratoxins in poultry feed and feed ingredients were 50%, the average and maximum contamination level were 21.95 and 97.5 ppb, respectively. About 63% of samples of poultry feed ingredients were contaminated with an average contamination level of 36.49 ppb. About 29% of finished feed samples were contaminated, the average and maximum contamination levels were 7.11 and 23 ppb, respectively(Fareed et al., 2014). The level of contamination of poultry feed samples from Ismailia governorate, Egypt, with Ochratoxins was found to be ranged from 7.10 to 20.72 ppb (Hassan et al., 2012). These results were lower than that of the current study this may be due to different environmental conditions, storage conditions and length of time between harvesting and consumption.

In conclusion, the hygienic conditions of the current poultry production system in Gharbia Governorate are not optimum. This would increase the likelihood of disease transmission between poultry farms and the likelihood of contamination of poultry feed with mycotoxins. Breeder companies and poultry feed traders could play a role in raising the awareness of poultry producers with the importance of hygiene and biosecurity. Further studies for the economic impacts of mycotoxins on poultry production are required.

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