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Internal and external biosecurity practices in poultry layer farms in Nyala, South Darfur State, Sudan

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KEYWORDS

Internal biosecurity
External biosecurity
Manure
Dead birds

ABSTRACT

The present study was conducted to evaluate quantitatively the internal and external biosecurity practices in layer farms in Nyala, South Darfur State, Sudan. Twenty-five commercial layer farms were investigated. Data were collected by means of a questionnaire. The respondents included farm owners, farm management and veterinarians. The overall biosecurity of the poultry farms was set up in two major categories, an internal and an external one. The two categories comprised a total of thirteen subcategories, each of which was given a score that ranged from 0.00 to 1.00. The overall score of the biosecurity in layer farms was 0.50. The score of the external biosecurity was 0.53 whereas that of the internal biosecurity was 0.64. The difference between the external and the internal biosecurity score was insignificant ($P>0.05$). No significant correlation ($P>0.05$) was observed between the scores of the external and the internal biosecurity. The highest score in the external biosecurity was observed in export of live animals, whereas the highest score in the internal biosecurity was found in disease management. Acceptable levels of biosecurity were found in measures related to the purchase of one day-old-chicks, as only 4% of the farms had poor practices. Strong positive correlation (0.48) was found between both removal of manure and dead animals, and infrastructure and biological vectors. The removal of manure and dead animals has also shown positive correlation (0.42) in relation to the entrance of visitors. In conclusion, the present study revealed poor biosecurity practices in layer farms in Nyala. More attention is recommended to raise the awareness of supervisors as well as farm owners on the importance of applying good farm biosecurity measures.

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INTRODUCTION

Poultry production has become one of the most popular and visible enterprises (Paul *et al.*, 2004). It is characterized by a huge diversity of production systems, with different scales of production, bird species, preventive measures, production inputs and outputs (Van Steenwinkel *et al.*, 2011).

In general, profitable poultry industry is always characterized by quick body gain and high egg production with less utilization of feed (Paul *et al.*, 2004). However, disease outbreaks will predominantly result in economic losses for individual farmers (Gelaude *et al.*, 2014). In order to tackle such issue, biosecurity has been considered as an essential component of modern flock health program.

Biosecurity is defined as a set of preventive measures designed to minimize the transmission of infectious diseases between and within farms (Dorea *et al.*, 2010).

In Sudan, few studies have carried out on biosecurity status in poultry farms (Mahmoud *et al.*, 2014; Tabidi *et al.*, 2014; Maisa, 2017). This is in addition to the fact that these studies were almost carried out in Khartoum State. Moreover, literature search has revealed no available data concerning biosecurity in poultry farms in Western Sudan, in particular in Nyala, the capital city of South Darfur State. Therefore, the present study was conducted to draw baseline information on the biosecurity status of poultry farms in the vicinity of Nyala city, South Darfur State, Sudan.

MATERIALS AND METHODS

Type, duration, and area of the study

The study was a cross sectional that was carried out during the period from August 2019 to December 2019 in Nyala city, the capital state of South Darfur.

Data were collected from 25 commercial layer farms which represented all the farms in the study area. Data on the internal and the external biosecurity measures were collected by means of a questionnaire that was designed according to the guidelines given by Gelaude*et al.* (2014). The questionnaire was conducted during the farm visits and each farm was visited every 3 days. The respondents were farm owners, farm managers and veterinarians.

The questionnaire included two main categories, an internal and an external biosecurity. Each category consisted of a set of subcategories. The external biosecurity consisted of 10 subcategories which were purchase of one day old chicks, source of feed, source of potable water, exports of live animals, feed supply, removal of manure and dead animals, entrance of visitors and personnel, supply of materials, infrastructure and biological vectors, location of farms. The internal biosecurity consisted of 3 subcategories which were disease management, cleaning and disinfection, materials and measures between compartments.

A score ranging from 0.0 to 1.0 was given to each subcategory. The scores were ranked as follows:<50% poor; 0.50 to0.70 good; 0.70 to 0.90 very good; 0.90 to 0.10excellent. The scores of the internal and the external as well as the overall biosecurity of each farm were calculated.

Data analysis

Data were analyzed by Statistical Packaging for the Social Sciences software program (SPSS, version 21 for Windows). Descriptive statistical analysis was applied on the collected data. The difference between the external and the internal biosecurity scores was applied using Student's T-test. The correlation between the external and the internal biosecurity scores was assessed by using Spearman's Rho Coefficient correlation test. The test was also conducted to examine the correlations between the subcategories of both biosecurity. Significant differences/correlations were reported when $p<0.05$.

RESULTS

All of the 25 farms examined in this study were open-floor system. The majority of the farms (96 %) had 1 to 5 houses; only one farm (4%) had more than 5 houses. The number of workers per farm was less than 5 in all farms.

The overall biosecurity score in layer farms in Nyala was 0.56. The score of external biosecurity was 0.53 whereas that of internal biosecurity was 0.64 (Table 1). The difference between the external and internal biosecurity scores was insignificant

($p>0.05$). In addition, no significant correlation ($p>0.05$) was observed between the scores of external and internal biosecurity.

Table 1: Ranking of the scores (Mean ±SD) of biosecurity in layer farms in Nyala, South Darfur (N= 25).

Item	Score	Rank
External biosecurity	0.53 ± 0.05	Good
Internal biosecurity	0.64 ±0.06	Good
Overall Biosecurity	0.56 ± 0.04	Good

SD: Standard deviation

The overall biosecurity was good in 88% of the farms and poor in 12% of them. Sixty eight percent of the farms has shown good external biosecurity practices whereas 72 % internal biosecurity has shown good practices (Fig. 1). Poor external biosecurity measures were observed in 32% of the farms. Most of the farms (88%) revealed acceptable score (good) for overall biosecurity but none of them displayed high level (excellent) of biosecurity (Figs. 1 and 2).

Table 2 displays the scores and ranks of the subcategories of the external and the internal biosecurity. Among the subcategories of external biosecurity, excellent practices (score 0.95) were recorded in export of live animals. Very good biosecurity measures were observed in location of the farm (score 0.71) and disease management (0.85) whereas good measures were seen in the subcategory purchase of one day old chicks (0.66), feed supply (0.59) and infrastructure and biological vectors (score 0.52). The remaining subcategories of external biosecurity had poor scores. The internal biosecurity demonstrated optimal score (0.85) but poor measures related to the remaining two subcategories were evident by low scores (0.45 and 0.30).

Table 3 shows the ranking of biosecurity subcategories in layer farms. The external biosecurity showed that all farms (100%) had poor biosecurity practices in relation to the source of potable water, and supply of materials subcategories. Nighty six percent revealed poor practices in terms of removal of manure and dead animals whereas 4% of the farms showed good practices. Poor practices related to entrance of visitors and personnel were also evident in 92 % of the farms whereas 8% of the farms showed good practices. About two third of the farms (64%) have shown poor measures of source of feed and 36% of them showed good measures. Different levels of biosecurity were seen in purchase of one day old chicks, in which only 4% of the farms had poor practices, 48% had good practices, 40% very good practices and the remaining 8% had excellent practices. High level of external biosecurity measures was only observed in the subcategory exports of live animals; 68% of the farms showed excellent practices, 24% showed very good practices but none of them exhibited poor practices. Regarding the internal biosecurity, all farms (100%) showed poor measures related to materials and measures between compartments. Poor cleaning and disinfection measures were also recorded in 92% of the farms. The implementation of disease management was excellent in 40% of the farms and very good in 56% of the farms and good in 4% of the farms.

Table 4 presents correlation between the scores of different subcategories of biosecurity. Positive correlation was observed between both purchase of one day old chicks and source of feed (0.41), and export of live animals (0.42) ($p<0.05$). In contrast, purchase of one day old chicks negatively correlated with materials and measures between compartments (- 0.40) ($p<0.05$). Export of live animals showed negative correlation between both feed supply (0.53) ($p<0.01$), along with materials and measures between compartments (-0.45) ($p<0.05$). Feed supply positively correlated with three subcategories, namely entrance of visitors and personnel (0.41), cleaning and disinfection (0.40), and materials and measures between compartments (0.43) ($p<0.05$). Removal of manure and dead animals demonstrated positive correlation with entrance of visitors and personnel (0.42), and infrastructure and biological vectors (0.48) ($p<0.05$). Cleaning and disinfection also showed positive correlation (0.41) with materials and measures between compartments ($p<0.05$).

Table 2: The overall ranking of the scores (Mean ±SD) of biosecurity subcategories in layer farms (N= 25) in Nyala, South Darfur.

Biosecurity	Subcategory	Score	Rank
External biosecurity	Purchase of one day old chicks	0.66±0.14	Good
	Source of feed	0.31±0.24	Poor
	Source of potable water	0.36±0.08	Poor
	Exports of live animals	0.95±0.16	Excellent
	Feed supply	0.59 ±0.12	Good
	Removal of manure and dead animals	0.31±0.15	Poor
	Entrance of visitors and personnel	0.27 ±0.10	Poor
	Supply of materials	0.22±0.25	Poor
	Infrastructure and biological vectors	0.52±0.13	Good
	Location of the farm	0.71±0.14	Very good
Internal biosecurity	Disease Management	0.85±0.10	Very good
	Cleaning and disinfection	0.45 ±0.08	Poor
	Materials and measures between compartments	0.30 ±0.25	Poor

SD: standard deviation; Poor: < 0.50 score; Good: score 0.50 to 0.70; Very good: score 0.70 to 0.90; Excellent: score 0.90 to 1.0

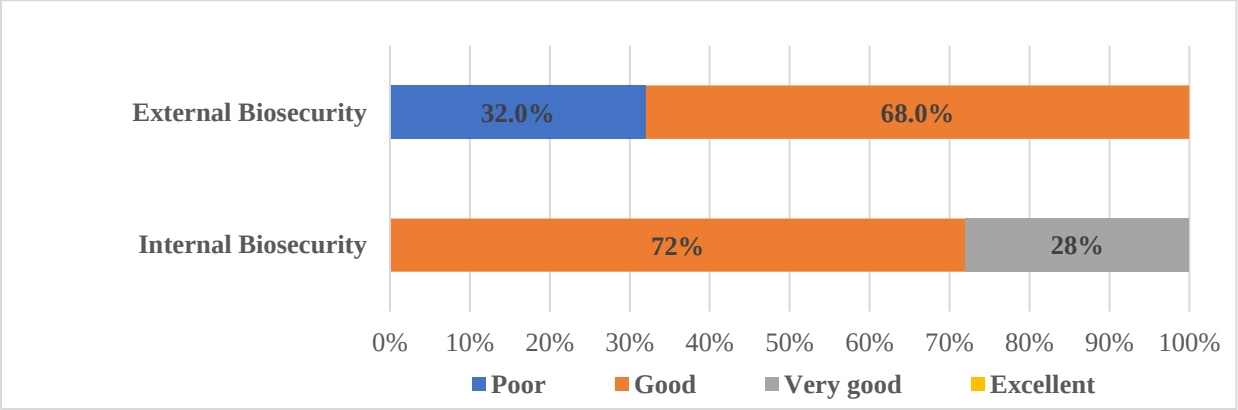

Figure 1: Ranks of the external and the internal biosecurity scores of layer farms in Nyala, South Darfur.

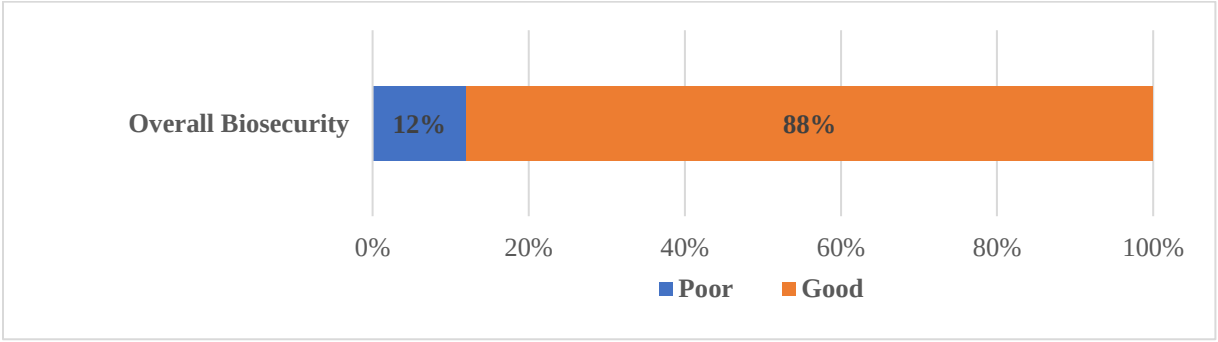

Figure 2: Ranks of overall biosecurity scores of layer farms in Nyala, South Darfur.

Table 3: Percentage of the ranks of biosecurity subcategories in layer farms (N= 25) in Nyala, South Darfur.

Biosecurity	**Subcategory**	**Rank**			
		P	**G**	**VG**	**E**
External biosecurity	Purchase of one day old chicks	4%	48%	40%	8%
	Source of feed	64%	36%	-	-
	Source of potable water	100%	-	-	-
	Exports of live animals	-	8%	24%	68%
	Feed supply	16%	60%	24%	-
	Removal of manure and dead animals	96%	4%	-	-
	Entrance of visitors and personnel	92%	8%	-	-
	Supply of materials	100%	-	-	-
	Infrastructure and biological vectors	40%	56%	4%	-
	Location of the farm	16%	40%	40%	4%
Internal biosecurity	Disease Management	-	4%	56%	40%
	Cleaning and disinfection	92%	8%	-	-
	Materials and measures between compartments	100%	-	-	-

P: poor (< 0.50); **G:** good (0.50-0.70); **VG:** very good (0.70-0.90); **E:** excellent (0.90-1.0).

Table 4: Correlation between biosecurity subcategories in layer farms (N= 25) in Nyala, South Darfur

Subcategories of biosecurity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1. Purchase of one day old chicks	-								
2. Source of feed	0.41*	-							
3. Exports of live animals	0.42*	- 0.02	-						
4. Feed supply	0.14	- 0.10	- 0.53**	-					
5. Removal of manure and dead animals	- 0.01	- 0.01	- 0.06	0.23	-				
6. Entrance of visitors and personnel	0.18	- 0.16	- 0.10	0.41*	0.42*	-			
7. Infrastructure and biological vectors	- 0.11	- 0.10	-0.05	- 0.27	0.48*	0.03	-		
8. Cleaning and disinfection	0.23	0.33	- 0.35	0.40*	0.06	0.35	- 0.04	-	
9. Materials and measures between compartments	- 0.40*	- 0.45*	- 0.42*	0.43*	0.10	0.26	0.03	0.41*	-

*p<0.05; ** p<0.01

DISCUSSION

The present study established for the first time the evaluation of the biosecurity in poultry farms in Darfur region, Sudan. The study utilized the scoring system published by Gelaude *et al.* (2014). However, it is not the first time to use such quantification system in Sudan, as it was previously used in the evaluation of biosecurity in layer farms in Khartoum State (Elhassan *et al.*, 2020). The unique feature of the scoring system is that not only it enables the quantification of biosecurity in poultry farms, but also takes the relative importance of the different biosecurity aspects into account (Gelaude *et al.*, 2014).The overall biosecurity in this study was good in 88% of the farms and only poor in 12% of them. Nevertheless, none of the investigated farms had excellent or even very good score.

Studies carried out on broiler farms in Europe by Van Limbergen *et al.* (2017) and Elhassan *et al.* (2020) in layer farms in Sudan, revealed that the score of external of biosecurity was remarkably lower than the score of internal biosecurity. It is plausible that broiler farmers obtained a clear benefit from improving internal biosecurity, such as implement a higher standard of hygiene in the broiler house, and consequently achieved high performance of animals (Postma *et al.*, 2016; Van Limbergen *et al.*, 2017). However, the present findings did not show significant differences between the levels of internal and external biosecurity. The buying of animals from different farms sources is considered as a greater risk of introduction of disease-causing agents. (Elhassan *et al.*, 2020). In the present study, acceptable different levels of biosecurity were seen in the purchase of one day old chicks. This may show the improved awareness among farm owners with biosecurity measures in terms of introducing new chicks.

The animal transport vehicles can also contribute to the disease-causing agents. (Hege *et al.*, 2002). In this study, the subcategory exports of live animals displayed the highest score. This indicates the high awareness among farm owners on biosecurity measures of cleaning and disinfection of the vehicles.

It is well known that the share of equipment between the stables or farms would certainly lead to greater risk of introduction of the disease-causing agents (Tabidi *et al.*, 2014; Lister *et al.*, 2008). In the present study, the subcategory supply of materials displayed the lowest biosecurity score as compared to other subcategories either in external or internal biosecurity. Similar findings have been reported by Elhassan *et al.* (2020) in layer farms.

Regarding the internal biosecurity in this study, disease management displayed the highest score as compared to other practices. This is in agreement with the findings given by Van Limbergen *et al.* (2017). The score of disease management might indicate the sufficient awareness of the adverse effects of poultry diseases amongst farm owners and supervisors. It is of great importance to apply biosecurity measures related to disease management such as isolation of infected birds, vaccination, and removal of dead birds (Gelaude *et al.*, 2014).

The present findings revealed not only a high biosecurity score of export of live animals, but also its strong negative correlation with the biosecurity score of feed supply. A possible explanation for the negative correlation might be due to the lack of applying simultaneous strict biosecurity measures on movements of both to and from the farm, indicating that farmers are applying strict measures on one direction only.

The present study showed poor biosecurity score in terms of removal of manure and dead animal as well as infrastructure and biological vectors. It is evident that dead birds and litter can be highly contaminated with pathogens (Lister *et al.*,2008). In addition, the aforementioned subcategories of external biosecurity in this study demonstrated strong positive correlation to each other. The positive correlate on could be attributed to that both subcategories are influenced by common factor, the lay out and construction of the farm. Further studies are needed to support this assumption.

Similarly, the present investigation showed that layer farms had acceptable level of cleaning and disinfection practices which positively correlated with the subcategory materials and measures between compartments. It seems that such

subcategories are correlated to each other because they may share the same hygiene measures.

CONCLUSIONS

The study showed low score of overall biosecurity practices applied to layer farms in Nyala City, South Darfur State, Sudan. The scores of external and internal biosecurity were more or less the same. More attention is recommended to raise the awareness of farm owners and supervisors on the optimum biosecurity measures and their impact on the overall flock health.

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