Inventory of biosecurity measures and antibiotics therapy practices on laying hen farms in Benin

Oscar N. C. Aguidissou, Cyrilke K. Boko, Camus M. Adoligbe, Clarisse H. Dete, Picole T. Capo-Chichi, Yao Akpo, Benoit G. Koutinhoun and Soualibou Farougou

Communicable Diseases Research Unit, Applied Biology Research Laboratory, Ecole Polytechnique Abomey-Calavi, University of Abomey-Calavi, 01 BP 2009, Cotonou, Benin.

Corresponding Author: Oscar N. C. Aguidissou, e-mail: nestoaguidos@gmail.com
Co-authors: CKB: cyrilkeboko@yahoo.fr, CMA: camus.adoligbe@epac.uac.bj, CHD: clarissedete@gmail.com, PTC: picolecapochichi@gmail.com, YA: yao.akpo@gmail.com, BGK: koutinhouing@yahoo.fr, SF: s.farougou@gmail.com

Received: 22-06-2020, Accepted: 02-11-2020, Published online: 17-12-2020

doi: www.doi.org/10.14202/vetworld.2020.2681-2690 How to cite this article: Aguidissou ONC, Boko CK, Adoligbe CM, Dete CH, Capo-Chichi PT, Akpo Y, Koutinhoun BG, Farougou S (2020) Inventory of biosecurity measures and antibiotics therapy practices on laying hen farms in Benin, Veterinary World, 13(12): 2681-2690.

Abstract

Background and Aim: Laying hen breeding is on the rise in Benin; nevertheless, there are several sanitary constraints to its development, including bacterial diseases. Faced with this situation, breeders mainly resort to different means of treatment. The objective of this study was to assess the current state of hygiene measures, the bacterial diseases commonly encountered, and antibiotic therapy practices on laying hen farms in Benin.

Materials and Methods: A total of 200 laying hen farms were randomly selected from lists of laying hen farms obtained from veterinary offices, territorial agricultural development agencies, and the Benin National Union of Professional Aviculturists. Each visited farmer was subjected to a semi-structured questionnaire by direct interview. The results were compared using the bilateral Z-test.

Results: The results of this survey revealed that 99.5% of the surveyed farms had a health and medical prophylaxis program although only 88.5% of them reported strictly adhering to it (p<0.001). About 25.0% of them reported that the dominant bacterial diseases they commonly encountered on their farms were salmonellosis, colibacillosis, and chronic respiratory disease. Only 7.0% of farmers said that they confirmed their diagnosis outside of clinical signs through laboratory analysis. To control these pathologies, 14.5% of farmers used only oxytetracycline, while 39.0% used other antibiotics such as colistin, enrofloxacin, tylosin, tylodox, flumequine, and norfloxacin. In comparison, 13.5% used a trimethoprim-sulfadimethoxine and sulfadimidine combination, while 32.0% said that they used erythromycin, oxytetracycline, streptomycin, neomycin, and colistin (p<0.001) combination.

Conclusion: This study highlights the inadequacies of hygiene and antibiotic therapy practices implemented on Benin’s laying hen farms.

Keywords: antibiotic therapy, bacterial diseases, biosecurity, laying hens.

Introduction

In Africa, government policies have been developed to promote short-cycle animal husbandry systems, such as poultry farming, to contribute to poverty alleviation and promote food self-sufficiency [1]. Thus, poultry farming has become a very important pillar for food security and economy in many African countries, particularly in West Africa, where poultry farming is growing rapidly [2]. For example, in Benin, (a country located in intertropical zone in West Africa), poultry farming is the second-largest source of animal protein production after cattle [3] with an estimated 19,830,000 birds produced in 2017, with its uncontrolled use is known to modify the ecology of bacteria and contribute to the selection of multidrug-resistant bacteria in animals and humans [9-13]. Another consequence of the misuse of antibiotics is the presence of active residues in animal...
products (eggs and meat). This can lead to adverse effects for the consumer, thus posing a public health problem [14,15]. Moreover, Boko et al. [16] showed that poultry farming practices in South Benin are still unsatisfactory. Given this, it is clear that urgent measures are needed that can reduce the use of antibiotics on laying hen farms. However, to develop any recommendations for farmers, knowledge of the current state of practices relating to the application of biosecurity measures and the use of antibiotics on laying hen farms is necessary.

The present study was carried out with the aim of taking stock of the biosecurity practices and bacterial diseases most commonly encountered by laying hen farmers in conjunction with their antibiotic therapy practices to be able to develop constructive recommendations.

Materials and Methods

Ethical approval and Informed consent

Ethical approval is not necessary for this type of study. However, informed consent was obtained from all the participants.

Equipment

The equipment used consisted of a survey form addressed to the farmers, a global positioning system device for the recording of the geographical coordinates of the various farms visited, and a camera.

Methods

Sampling plan

The sampling was carried out; from June to November 2019 in several municipalities (Figure-1), taking into account, the zoning adopted by the UNAP and DE in Benin and the last census carried out by the Milk and Meat Value Chain Improvement Project (PAFILA V) in 2015. In fact, in 2015, the four zones adopted by UNAP and the DE featured 719 modern poultry farmers (layers, broilers, and cockerels) with 381, 125, 168, and 45, respectively, for zone 1, zone 2, zone 3, and zone 4. The target population in this study consisted solely of laying hen breeders. Thus, 200 laying hen farms were randomly selected based on the density of farms per zone and from the lists of breeders obtained from veterinary offices, territorial agricultural development agencies (ATDA), and UNAP (Table-1). This sample size is justified by our limited resources and by the fact that some breeders refused to receive us because of the lack of feedback from the previous studies. However, according to Singleton [17], while a sample size of 2000-3000 is considered an extreme upper limit, the extreme lower limit is usually 30 cases for statistical analysis. He also adds that most social scientists would recommend a sample size of 100. Therefore, the sample size for this study is representative.

Data collection

The visited farmers were subjected to a semi-structured questionnaire by direct interview for the data collection on sociodemographic characteristics, farm management, biosecurity measures, dominant bacterial diseases, and antibiotic therapy practices within the farm. Each breeder was contacted 48 h before our visit for consent and to arrange an appointment. One enumerator was assigned to two zones but before the survey, the enumerators were trained on the use of the questionnaire to maintain consistency across all the interviews.

Statistical analysis

The data collected were coded and recorded in the Excel designed database. The frequencies were calculated in relation to farm management, biosecurity measures, dominant bacterial diseases, and antibiotic treatment practices. Then, these frequencies were compared with each other using the bilateral Z-test. For each relative frequency, a 95% confidence interval (CI) was calculated according to the formula:

\[
ICP = 1.96 \sqrt{\frac{P(1-P)}{N}}
\]

Where, \(P\) is the relative frequency and \(N\) is the sample size.

All the analyses were performed with the R 3.5.2. software (Foundation for Statistical Computing, Vienna, Australia) [18] and the graphs were designed using GraphPad Prism 5.0.0 (San Diego, California, USA) [19].

Results

Sociodemographic characteristics

Altogether 200 farmers were selected included 103 (zone 1), 56 (zone 2), 19 (zone 3), and 22 from zone 4. Of the 200 farmers, 86.5% were male, compared to only 13.5% of females. About 94.0% were

| Zones                  | Departments                          | Municipalities                              | Numbers | Percentage |
|------------------------|--------------------------------------|---------------------------------------------|---------|------------|
| Zone 1 Atlanticique-Littoral | Abomey-Calavi, Zè, Allada, Cotonou,Tori-Bossito, Ouidah | 103 | 51.50 |
| Zone 2 Ouémé-Plateau              | Sèmè, Porto-Novo, Avrankou, Ifangni, Sakété, Adjarra, Dangbo, Adjá-Ouéré | 56 | 28.00 |
| Zone 3 Mono-Couffo-Zou-Collines | Comè, Aplahoué, Djakotomè, Grand-Pop, Abomey, Zogbodomey, Dijia | 19 | 9.50 |
| Zone 4 Borgou-Alibori-Atacora-Donga | Natitingou, Kandi, Tchaourou, N’dali, Ouèssè, Parakou, Bembéréké, Tchaourou | 22 | 11.00 |
| Total                   |                                      |                                             | 200     | 100        |
adults (25-64 years old), 5.0% were old (≥65 years old), and only 1.0% were young (21-24 years old). Almost all of the farms surveyed (98.5%) were privately owned (Figure-2).

Management of the visited farms

Table-2 provides information on the management of the various farms. The table shows that 96.0% of the farmers only produced layers, 2.5% combined layers and broilers, 1.0% combined layers and cockerels, and only 0.5% produced layers, broilers, and cockerels. Although our survey revealed four breeding methods, majority of the farmers rear their animal on the ground (92.0%). On 22.5% of the farms, chickens coop was spaced 15-30 m from each other. As regards the size of the livestock on the various farms, most farmers (37.0%) owned 1001-5000 heads (Figure-3).

Biosecurity measures

About 79.5% of the farms were fenced. Only 8.0% of these farms had wheel dips in front of their farms, while 77.0% of them had footbaths in front of each hen house. Only 12.5% of the farms stated that they had special boots for visitors. With regard to corpses management (Table-3), 80.0% of the farmers...
stated that they buried them, 7.5% incinerated them, and 5.0% preferred to sell them for human consumption (p<0.001). More than half (55.5%) of them said that they changed their litter when it was dirty and a minority (2.5%) did so every 6 months. About 83.5% of them said that they sold the collected litter to market gardeners, 10.5% used it in their fields near the farm. However, 1.5% of the surveyed farms stored the litter in an area on the farm. All the farmers stated that the drinking troughs are cleaned every day. With regard to the medical prophylaxis plan, (Table-3), almost all (99.5%) of the surveyed farms had a medical prophylaxis plan and 88.5% of them strictly adhered to it (p<0.001). More than half of the farmers (69.0%) fed borehole water to the animals (Figure-4) and only 18.0% of them stated that they periodically disinfected the drinking water source.

**Bacterial diseases encountered and antibiotic therapy practices**

About 25.0% of the farmers reported that the dominant bacterial diseases they commonly encountered were salmonellosis, colibacillosis, and chronic respiratory disease. About 18.5% reported only encountering chronic respiratory disease, 10.5% encountered both colibacillosis and chronic respiratory disease, and 25.5% encountered none of these diseases (p<0.001). Only 26.0% of the farmers stated that they were vaccinated against salmonellosis (Table-4). In the presence of these pathologies, only 49.0% of the farmers used veterinarians for diagnosis, while 39.5% did it by themselves and 11.5% used technicians. Almost half (49.0%) of the farmers said that they based their diagnosis on clinical signs, while only 7.0% of them confirmed their diagnosis by laboratory analysis outside of clinical signs (p<0.001). To treat the pathologies, 14.5% of the breeders only used oxytetracycline, 39.0% used various different antibiotics including oxytetracycline but also colistin, enrofloxacin, tylosin, tyloxoxy, flumequine, and norfloxacin, 13.5% used a combination of trimethoprim-sulfadimethoxine and sulfadimidine, while 32.0% stated that they used a combination of erythromycin, oxytetracycline, streptomycin, neomycin, and colistin (Table-4) (p<0.001). Nearly all farmers (99.0%) said that they purchased these antibiotics from veterinary pharmacies, while 1.0% purchased them from veterinary pharmacies and the informal sector in Nigeria. In addition, more than half (56.0%) of the farmers used these antibiotics for prevention and treatment, 25.5% for treatment, and 17.5% for prevention (p<0.01). Of the 200 farmers interviewed, 74.5% of the farmers interviewed reported after treatment, they obtained the expected result (Table-4), while 4.0% of the farmers reported that they did not obtain the expected result (p<0.001).
### Table-2: Farms management.

| Variable                      | Numbers | Frequency (%) | IC   | Z-test |       |
|-------------------------------|---------|---------------|------|--------|-------|
| **Other types of speculation** |         |               |      |        |       |
| Broilers                      | 5       | 2.5<sup>a</sup> |      | 2.16   | ***   |
| Cockerels                     | 2       | 1.0<sup>a</sup>  |      | 1.38   |       |
| Broilers and cockerels        | 1       | 0.5<sup>a</sup>  |      | 0.98   |       |
| Layers                        | 192     | 96.0<sup>b</sup> |      | 2.72   |       |
| **Number of chicken coops**   |         |               |      |        |       |
| 1                             | 57      | 28.5<sup>a</sup> |      | 6.26   | ***   |
| 2-5                           | 124     | 62.0<sup>b</sup> |      | 6.73   |       |
| 6-9                           | 10      | 5.0<sup>c</sup>  |      | 3.02   |       |
| 10 and over                   | 9       | 4.5<sup>c</sup>  |      | 2.87   |       |
| **Breeding method**           |         |               |      |        |       |
| On the ground                 | 184     | 92.0<sup>a</sup> |      | 3.76   | ***   |
| In battery                    | 7       | 3.5<sup>bc</sup> |      | 2.55   |       |
| Ground and battery            | 8       | 4.0<sup>b</sup>  |      | 2.72   |       |
| Overwater                     | 1       | 0.5<sup>c</sup>  |      | 0.98   |       |
| **Distance of 15-30 m between two chicken coops** | | | | | |
| No                            | 155     | 77.5<sup>a</sup> |      | 5.79   | ***   |
| Yes                           | 45      | 22.5<sup>b</sup> |      | 5.79   |       |

***=p<0.001, the frequencies of the same column followed by a different letter, differ significantly at the 1%<sub>oo</sub> threshold.

### Table-3: Biosecurity measures.

| Variable                      | Numbers | Frequency (%) | IC   | Z-test |       |
|-------------------------------|---------|---------------|------|--------|-------|
| **Presence of a fence**       |         |               |      |        |       |
| Yes                           | 159     | 79.5<sup>a</sup> |      | 5.60   | ***   |
| No                            | 41      | 20.5<sup>a</sup> |      | 5.60   |       |
| **Presence of a gate/door**   |         |               |      |        |       |
| Yes                           | 160     | 80.0<sup>a</sup> |      | 5.54   | ***   |
| No                            | 40      | 20.0<sup>a</sup> |      | 5.54   |       |
| **Presence of wheel dips**    |         |               |      |        |       |
| Yes                           | 16      | 8.0<sup>a</sup>  |      | 3.76   | ***   |
| No                            | 184     | 92.0<sup>a</sup> |      | 3.76   |       |
| **Presence of footbath by chicken coop** | | | | | |
| Yes                           | 154     | 77.0<sup>a</sup> |      | 5.83   | ***   |
| No                            | 46      | 23.0<sup>a</sup> |      | 5.83   |       |
| **Outfits for visitors**      |         |               |      |        |       |
| Yes                           | 11      | 5.5<sup>a</sup>  |      | 3.16   | ***   |
| No                            | 189     | 94.5<sup>a</sup> |      | 3.16   |       |
| **Visitor boots**             |         |               |      |        |       |
| Yes                           | 25      | 12.5<sup>a</sup> |      | 4.58   | ***   |
| No                            | 175     | 87.5<sup>a</sup> |      | 4.58   |       |
| **Management of corpses**     |         |               |      |        |       |
| Buried                        | 160     | 80.0<sup>a</sup> |      | 5.54   | ***   |
| Cremated                      | 15      | 7.5<sup>a</sup>  |      | 3.65   |       |
| Thrown onto the garbage       | 3       | 1.5<sup>a</sup>  |      | 1.68   |       |
| Used in animal feed           | 12      | 6.0<sup>a</sup>  |      | 3.29   |       |
| Sold for human consumption    | 10      | 5.0<sup>c</sup>  |      | 3.02   |       |
| **Litter renewal frequency**  |         |               |      |        |       |
| When it is dirty              | 111     | 55.5<sup>a</sup> |      | 6.89   | ***   |
| 2 weeks                       | 2       | 1.0<sup>a</sup>  |      | 1.38   |       |
| 3 months                      | 22      | 11.0<sup>a</sup> |      | 4.34   |       |
| 6 months                      | 5       | 2.5<sup>a</sup>  |      | 2.16   |       |
| Every month                   | 60      | 30.0<sup>a</sup> |      | 6.35   |       |
| **Litter management**         |         |               |      |        |       |
| Composted                     | 6       | 3.0<sup>a</sup>  |      | 2.36   | ***   |
| Stored in an area on the farm | 3       | 1.5<sup>a</sup>  |      | 1.68   |       |
| Sold to market gardeners      | 167     | 83.5<sup>a</sup> |      | 5.14   |       |
| Spreading in nearby fields    | 21      | 10.5<sup>c</sup> |      | 4.25   |       |
| Thrown onto the garbage       | 3       | 1.5<sup>a</sup>  |      | 1.68   |       |
| **Food source**               |         |               |      |        |       |
| Made by the chicken farmer    | 25      | 12.5<sup>a</sup> |      | 4.58   | ***   |
| Made by the chicken farmer and supplied by a factory | 12 | 6.0<sup>a</sup> | | 3.29 | |
| Supplied by a factory         | 163     | 81.5<sup>a</sup> |      | 5.38   |       |

(Contd…)
Discussion

Sociodemographic characteristics

The results of this study revealed that the majority of the laying hen breeders were male. These results are similar to those obtained in 2015 in Benin by PAFILAV [20], featuring 90.0% of men against 10.0% of women. They are also similar to those obtained by Adebowale et al. [11] who found that 71.8% of the interviewed farmers were male and 14.6% were female. The rearing of laying hens in Benin is, therefore, and continues to be a male-dominated activity. According to our study, this type of farming is practiced much more by adults (25-64 years old). Similar results were obtained by PAFILAV [20], who stated that 52.0% of the poultry farmers fall into the age range of 36-54 years old.

Management of the visited farms

In the majority of the farms, the buildings were not sufficiently spaced. These results corroborate to those obtained in Benin [16]. The proximity of livestock buildings on the farms would constitute a risk of airborne contamination from one building to another in the event of a contagious disease. Indeed, the distance between two buildings should not be less than 30 m to limit any risk of contamination [21]. On the basis of a previous study of FAO [22], poultry enterprises in Benin can be classified into three groups that include small enterprises (<1000), medium enterprises (1000-5000), and big enterprises (>5000). However, our study showed that majority of our respondents were medium-sized farm owners. Our results are different from those obtained by PAFILA V [20], who had shown that the majority of the laying hen breeders own small-sized farms. This finding could be due to the fact that breeding laying hens have developed over time [23,24] due to change in people’s lifestyle and the increasing demand in animal source food.

Biosecurity measures

The lack of fences in some farms could be the result of limited financial means or unwillingness of these farmers to build a fence. However, the study conducted in Mali [25] reported that many more laying hen breeders did not have a fence. This could constitute a risk of permanent exposure of the farm to live vectors which are often sources of contamination. The majority of our respondents had a footbath in front of each hen house and a few had a wheel dip. Similar observations were made by PAFILAV [20] in Benin. These results might suggest that most farmers in Benin are more aware of the importance of footbaths at the entrance to each chicken coop than of the importance of wheel dips at the entrance to the farms. Our results are different from those reported by Traoré [25], who found that only 13.04% of the farms surveyed had footbaths and none of them had wheel dips at the farm entrance. Furthermore, only 12.5% of the farmers had special boots for visitors. These results could be linked to the lack of information or negligence on the part of most farmers in managing visitors. This is because Article 6.5.5 of the Terrestrial Animal Health Code states that “All visitors entering a poultry house are required to

---

Table 3 (Continued)

| Variable                               | Numbers | Frequency (%) | IC   | Z-test |
|----------------------------------------|---------|---------------|------|--------|
| Frequency of cleaning drinkers         |         |               |      |        |
| Every day                              | 200     | 100*a         | 0    | ***    |
| Others                                 | 0       | 0.0*b         | 0    |        |
| Drinking water disinfection            |         |               |      |        |
| Yes                                    | 36      | 18.0*a        | 5.32 | ***    |
| No                                     | 164     | 82.0*b        | 5.32 |        |
| Medical prophylaxis plan               |         |               |      |        |
| Yes                                    | 199     | 99.5*a        | 0.98 | ***    |
| No                                     | 1       | 0.5*b         | 0.98 |        |
| Compliance with the medical prophylaxis plan |       |               |      |        |
| Yes                                    | 177     | 88.5*a        | 4.42 | ***    |
| No                                     | 23      | 11.5*b        | 4.42 |        |

***p<0.001, the frequencies of the same column followed by a different letter, differ significantly at the 1% threshold.

---

Figure 4: Drinking water source.
change footwear or use a boot spray and a foot bath containing a properly maintained disinfectant” [26]. With respect to corpses, our results showed that the majority of the farmers have mastered the concept of corpses management and proceeded with burial. However, incineration remains the best method of disposal of corpses because it limits the spread and persistence of germs on farms [25]. Our results are different from those obtained by Wouembe [1], who reported that 10.0% of farmers in Cameroon bury chicken corpses. Furthermore, some of them preferred to sell the corpses for human consumption. Indeed, human consumption of dead chickens would constitute a risk factor in the transmission of certain zoonotic diseases such as salmonellosis [27]. This practice could be explained by the lack of information on zoonotic diseases among these farmers. Concerning the medical prophylaxis plan, our results corroborate those obtained in Benin [16], who also reported that 97.4% of the farms surveyed strictly applied the prophylaxis program. The failure of some farms in our study to rigorously comply with the prophylaxis program could be explained by negligence on the part of the farmers or by a lack of financial resources. The majority of producers sold the collected litter to market gardeners and a few used it in their fields close to the farm. These results are similar to those obtained by PAFILA V [20] in Benin, who also reported in their survey that 81.0% of breeders sold the collected litter to market gardeners, compared to only 16.0% who used it in fields close to their farms. This is explained by the high demand for manure by market gardeners in Benin. However, 1.5% of the farms surveyed stored the litter in one area of the farm, which exposes their farms to the risk of permanent contamination of successive strips.

Table-4: Bacterial pathologies encountered and antibiotic therapy practices.

| Variable | Numbers | Frequency (%) | IC | Z-test |
|----------|---------|---------------|----|--------|
| Dominant bacterial disease | | | | |
| Salmonellosis | 16 | 8.0a | 3.76 | *** |
| Colibacillosis | 5 | 2.5b | 2.16 | |
| Chronic respiratory diseases | 37 | 18.5c | 5.38 | |
| Salmonellosis and colibacillosis | 8 | 4.0p | 2.72 | |
| Salmonellosis and chronic respiratory diseases | 12 | 6.0e | 3.29 | |
| Salmonellosis, colibacillosis, chronic respiratory diseases | 21 | 10.5p | 4.25 | |
| No | 51 | 25.5a | 6.04 | |
| Vaccination | | | | |
| Salmonellosis | 52 | 26.0a | 6.08 | *** |
| No | 148 | 74.0b | 6.08 | |
| Diagnostic | | | | |
| Veterinary | 98 | 49.0a | 6.93 | *** |
| Poultry farmer | 79 | 39.5a | 6.78 | |
| Technician | 23 | 11.5a | 4.42 | |
| Confirmation of diagnosis | | | | |
| Clinical signs | 98 | 49.0a | 6.92 | *** |
| Clinical signs and autopsy | 74 | 37.0b | 6.69 | |
| Clinical signs, autopsy, and laboratory analysis | 14 | 7.0c | 3.53 | |
| No | 14 | 7.0c | 3.53 | |
| Antibiotics used | | | | |
| Oxytetracycline | 29 | 14.5a | 4.87 | *** |
| Oxytetracycline, colistin, enrofloxacin, tylosin, tyldox, flumequine, norfloxacin | 78 | 39.0a | 6.75 | |
| Trimethoprim, sulfadimethoxine, sulfadimidine | 27 | 13.5a | 4.73 | |
| Erythromycin, oxytetracycline, streptomycin, neomycin, colistin | 64 | 32.0a | 6.46 | |
| Prescription | | | | |
| Veterinary | 102 | 51.0a | 6.93 | *** |
| Technician | 76 | 38.0a | 6.73 | |
| Self-medication | 22 | 11.0a | 4.34 | |
| Drug supply | | | | |
| Veterinary pharmacy | 198 | 99.0a | 1.38 | *** |
| Veterinary pharmacy and market | 2 | 1.0b | 1.38 | |
| How to use | | | | |
| Preventive | 35 | 17.5a | 5.27 | *** |
| Curative | 51 | 25.5a | 6.04 | |
| Preventive and curative | 112 | 56.0b | 6.88 | |
| Achievement of the expected result | | | | |
| Yes | 149 | 74.5a | 6.04 | *** |
| No | 8 | 4.0p | 2.72 | |
| Often | 43 | 21.5a | 5.69 | |

***=p<0.001, the frequencies of the same column followed by a different letter, differ significantly at the 1/80 threshold
Bacterial diseases encountered and antibiotic therapy practices

As a result of this survey, the dominant bacterial diseases commonly encountered on the farms were salmonellosis, colibacillosis, and chronic respiratory disease. The same observation was made in Algeria [28] and in Senegal [29], who also listed these diseases on laying hen farms. However, the occurrence of these diseases is most frequent in the unvaccinated farm. What may imply that failure to strictly comply with prophylactic measures by some farmers is the main reason of the occurrence of these diseases. Furthermore, the non-compliance of hygienic and sanitary rules as it is supposed to be done, the poor management of visitors and manure could also favor the persistence of these pathologies.

In the presence of these pathologies, only a handful of breeders confirmed their diagnosis outside the clinical signs by laboratory analysis. Our results are different from those obtained in Algeria [30], who reported that 25.0% of the vet monitored farms confirmed their diagnosis by laboratory analysis. Our results showed that many laying hen breeders were unaware of the importance of laboratory diagnosis and did not follow all the diagnostic steps before using antibiotics. Indeed, for an accurate diagnosis in avian pathology, after the anamnesis, a general examination should be carried out, an autopsy of a representative number of corpses should be performed and then additional laboratory tests should be requested for confirmation [25,31]. The lack of laboratory confirmation of the diagnosis by farmers could also be explained by the fact that Benin does not have enough veterinary diagnostic laboratories to assist farmers in this process. This constitutes a limitation in the strict application of the diagnostic process.

To deal with bacterial diseases, antibiotics most used for prevention and treatment by these farmers were oxytetracycline, colistin, enrofloxacin, tylosin, tyldox, flumequine, norfloxacin, erythromycin, streptomycin, neomycin, and the combination of trimethoprim-sulfadimethoxine and sulfadimidine. These results are similar to those obtained in Cameroon [32], Nigeria [11], and Benin [27]. The common use of these molecules on laying hen farms could be explained by the fact that some hatcheries and veterinary clinics offer farmers prophylactic programs in which anti-stress, anticoelidial, and antibiotic drugs are used for a long time during the growth of the animals. Moreover, failure to strictly comply with biosecurity measures and self-medication practiced by some farmers could also contribute to the excessive and uncontrolled use of these antibiotics. Furthermore, some of the farmers claimed that they did not obtain the expected result after using the antibiotics. This is likely related to misdiagnosis or mis-application of the prescribed antibiotics. It could also be due to the development of pathogens’ resistance to antibiotics or to the poor quality of the antibiotics, especially if they are from dubious sources. In fact, when faced with pathology on a farm, the recommended conduct generally involves the prescription of a broad-spectrum antibiotic. However, the prescription of a broad-spectrum antibiotic is applied when the offending pathogen has not yet been identified [33]. Thus, most farmers use antibiotics in an uncontrolled manner [32,34]. This practice not only promotes the presence of antibiotic residues in eggs and meat for human consumption [14,15], but also favors the emergence of multiresistant pathogens such as Salmonella and Escherichia coli on laying hen farms [5,35]. However, this resistance should not be systematically blamed in cases of treatment failures because other factors may be involved [36]. This is the case with misdiagnosis or incomplete diagnosis, a common situation when some farmers are satisfied with the clinical examination alone without resorting to laboratory tests before initiating antibiotic therapy [25]. This is also the case with the antagonistic effects associated with the combination of a bacteriostatic antibiotic with a bactericide [31].

This study thus highlights the different antibiotics commonly used by poultry breeders in Benin. It also highlights the biosecurity practices on these farms, which are still unsatisfactory, and draws attention to the importance of laboratory diagnosis by farmers. This will help to regulate or reduce the bad practices associated with antibiotic use by farmers in Benin.

Conclusion and Recommendations

To highlight the biosecurity practices, antibiotic therapy practices, and bacterial diseases commonly encountered by laying hen breeders in Benin, a retrospective survey was carried out among breeders. At the end of this survey, it was found that most breeders make an effort to respect the hygienic-sanitary rules. However, some irregularities were observed in the management of visitors, corpses, and manure.

Three major bacterial diseases such as salmonellosis, colibacillosis, and chronic respiratory disease are commonly encountered by farmers. Faced with these pathologies, they resort to several antibiotics that they use both preventively and curatively. In addition, most of them do not resort to laboratory diagnosis before the application of different antibiotics. It would, therefore, be advisable to strengthen the bodies responsible for monitoring and controlling the import and sale of antibiotic products, to increase the number of veterinary diagnostic laboratories, to raise awareness among farmers on the importance of complying with biosafety measures and laboratory diagnosis, to regulate the use of antibiotics on Benin’s laying hen farms, and finally, to promote and encourage research into pharmacological substances to limit the use of antibiotics on laying hen farms.
Authors’ Contributions

ONCA and CKB contributed to the work designing, data collection, and manuscript drafting. CMA and CHD Clarisse performed data analysis and revised the document. PTC contributed to data collection. YA, BGK, and SF revised the document. All authors have read and approved the final manuscript.

Acknowledgments

The authors would like to express their sincere gratitude to the Directorate of Livestock, the UNAP, the ATDA, and the various Veterinary Offices in Benin for their support and guidance. The authors are equally grateful to all the farmers for their time. The authors did not receive any funds for this study.

Competing Interests

The authors declare that there are no competing interests.

Publisher’s Note

Veterinary World remains neutral with regard to jurisdictional claims in published map and institutional affiliation.

References

1. Wouembe, K.F.D. (2013) Analyse de L’usage des Antibiotiques Dans les Elevages Avicoles Modernes: Cas de la Région de L’ouest du Cameroun. Thèse Médecine Veterinary, Faculté de Médecine, de Pharmacie et d’Odontologie de Dakar. p24.
2. AL Hassan, M.B. (2012) La Colibacillose du Poulet de Chair: Étude Anatomo-Clinique et Circumstances D’apparition Dans la Zone Périurbaine de Dakar (Sénégal). Thèse Médecine Veterinary, École Inter-États des Sciences et Médecine Vétérinaires, Sénégal. p18-24.
3. Dognon, S.R., Saliou, C.F.A., Dougon, J., Dahouda, M., Scippo, M.L. and Youssao, A.K.I. (2018) Meats import, quality, processing and consumption in Benin. J. Appl. Bioc., 124: 12476-12488.
4. Al Hassan, M.B. (2018) Rapport Annuel 2017, République du Bénin. Direction de l’Elevage, Senegal. p70.
5. Aguidissou, N.O., Boko, C.K., Sessou, P., Yovo, M., Komagbe, S.G., Ayihou, Y., Alitonou, G.A., Avlessi, F., Farougou, S. and Ssohounhle, K.C.D. (2019) Antibacterial activity of essential oil of Aelanthus pubescens on multi-drug-resistant strains of Salmonella and Escherichia coli isolated from laying hens farming in Benin. Adv. Microbiol., 9: 804-823.
6. Beshiri, A., Igbinosa, I.H. and Igbinosa, E.O. (2016) An investigation on antibiotic characteristics of Escherichia coli isolated from piggery farms in Benin City, Nigeria. Ann. Sci. Technol., 1(1): 8-12.
7. Dougon, T.V., Dégouén, E., Fahn, L., Légba, B., Houmanou, J.M.G., Agbangbé, J., Amadou, A., Koudokpon, H., Fabiyi, K., Aniambossou, A., Assouga, P., Houssna, E., de Souza, M., Avlessi, F., Dougon, T.J., Gbaguidi, F., Boko, M., Bankolé, H.S. and Baba-Moussa, L. (2017) Traditional treatment of human and animal salmonelloses in Southern Benin: Knowledge of farmers and traditionalists. Vet. World., 10(6): 580-592.
8. Bada-Alambedji, R., Akakpo, A.J., Teko-Agbo, A., Chataigner, B., Stevens, B. and Gadin, B. (2008) Contrôle des résidus: Exemple des antibiotiques dans les aliments au senegal [communication]. In: Conférence de l’OIE Sur Les Médicaments Vétérinaires en Afrique: Harmonisation et Amélioration de L’enregistrement de la Distribution et du Contrôle Qualité.
9. Baquero, F. and Garau, J. (2010) Prudent use of antimicrobial agents: Revisiting concepts and estimating perspectives in a global world. Enferm. Infecc. Microbiol. Clin., 28(8): 487-488.
10. Sessou, P., Yaovi, A.B., Yovo, M., Gamedjo, J., Dossa, F., Aguidissou, N.O., Boko, C.K., Alitonou, G., Farougou, S., and Sohounhle, D. (2018) Phytochemistry and antibacterial activity of plants extracts compared with two commercial antibiotics against E. coli responsible for avian colibacillosis in Benin. Int. J. Phytochem., 10(3): 168-174.
11. Adebowaile, O.O., Adeyemo, O.K., Awoyomi, O., Dada, R. and Adebowaile, O. (2016) Antibiotic use and practices in commercial poultry laying hens in Ogun State Nigeria. Rev. Elev. Méd. Vét. Pays Trop., 69(1): 41-45.
12. Atuanya, E.I., Nwogu, N.A. and Orah, C.U. (2018) Antibiotic resistance and plasmid profiles of bacteria isolated from abattoir effluents around Ikpoba River in Benin City, Nigeria. J. Appl. Sci. Environ. Manag., 22(11): 1749-1755.
13. Igbinosa, E.O. and Beshiri, A. (2019) Characterization of antibiotic resistance and species diversity of staphylococci isolated from apparently healthy farm animals. Afr. J. Clin. Exp. Microbiol., 20 (4): 299-298.
14. Bada-Alambédji, R., Chataigner, B., Clarisse, E., Biagui, C. and Akakpo, A.J. (2004) Identification of antibiotic residues in chicken meat consumed in Dakar (Senegal). Bull. Acad. Vét. France, 157(2): 67-70.
15. Mensah, S.E.P., Kouandé, O.D., Sanders, P., Laurentien, M., Mensah, G.A. and Abiola, F.A. (2014) Antibiotics Residues and animal-source food in Africa: Risks for public health. Rev. Sci. Tech., 33(3): 975-986.
16. Boko, M.A., Dougon, T.V., Bankolé, H.S., Dougon, T.J., Ahoangninou, C., Cledjo, P. and Soumanou, M. (2015) Poultry farming practices in South-Benin (West Africa) and impacts on the sanitary quality of produced manure. Int. J. Biol. Chem. Sin., 9(6): 2740-2753.
17. Singleton, R.B. (1993) Approaches to Social Research. 2nd ed. Oxford University Press, New York.
18. R Core Team. (2019) R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Australia. Available from: https://www.r-project.org. Retrieved on 02-12-2020.
19. GraphPad Software. (2008) GraphPad Prism 5.0.0. for Windows. GraphPad Software, San Diego, California USA. Available from: https://www.graphpad.com. Retrieved on 02-12-2020.
20. Projet’Appui aux Filières Lait et Viande(PAFILAV) (2015) Etude de la Filière Avicole au Bénin: Géoréférencement et Recensement. Exhausitif des Cheptels Avicoles Moderne et Traditionnel. Rapport de la Direction de la Production Animale, République du Bénin. p9-118.
21. Groupement Interprofessionnel des Produits Avicoles et Cunicoles (GIPAC). (2017) Guide de Biosécurité Dans Les Elevages Avicoles au Moyen Orient et en Afrique de Nord. Available from: https://www.usse.org/wp-content/uploads/2017/05/biosecurity-guide-french-12.pdf. Retrieved on 23-04-2020.
22. FAO. (2015) Secteur Avicole Bénin. Revues Nationales de L’élevage de la Division de la Production et de la Santé Animales de la FAO No. 10. FAO, Rome. p74.
23. Centre d’Actions Pour L’Environnement et le Développement Durable (ACED). (2017) Opportunités D’Affaires Pour Les Jeunes au Sein des Chaines De Valeur Agricoles. Rapport D’étude, Abomey-Calavi, République du Bénin. p75.
24. Direction de L’Elevage (2019) Rapport Annuel. Direction de L’Elevage, République du Bénin. p72.
25. Traoré, A.B. (2016) Evaluation des Pratiques Avicoles et de L’antibiörésistance des Salmonelles Isolées Chez Les Poules Pondeuses en Zone Périurbaine de Bamako (Mali).
26. Organisation Mondiale de la Santé Animale (OIE). (2019) Code Sanitaire Pour les Animaux Terrestres. 28th éd. Organisation Mondiale de la Santé Animale, Paris. Available from: http://www.oie.intconsultele. Retrieved on 23-03-2020.

27. Deguenon, E., Dougnon, V., Lozes, E., Maman, N., Agbankpe, J., Abdel-Massih, R.M., Djegui, F., Baba-Moussa, L. and Dougnon, J. (2019) Resistance and virulence determinants of faecal Salmonella spp. isolated from slaughter animals in Benin. BMC Res. Notes, 12: 317.

28. Nassim, S., Belalimi, N.E.H., Lezzar, N. and Aussi, A. (2015) Bilan des Maladies Aviaires Recensées au Niveau de Certains Elevages Avicoles dans la Wilaya de Bordj Bou Arreridj au Cours de L’année 2013-2014. Onzièmes Journées de la Recherche Avicole et Palmipède à Foie Gras, Tours.

29. Niyibizi, B. (2012) Etude Préliminaire Sur L'utilisation des Antibiotiques dans les Elevages de Poules Pondeuses de la Région de Dakar et la Présence de Résidus D’antibiotoques dans les Œufs. Mémoire de Master en Qualité des Aliments de L’homme. Université Cheikh Anta Diop de Dakar, Sénégal. p40.

30. Boulechbak, M. and Hanou, M. (2019) Enquête sur les Pratiques de L'antibiothérapie en Elevage Avicole, Thèse Médecine Veterinary. Institut des Sciences Vétérinaires Dahli, Algérie. p26-30.

31. Messaï, A. (2006) Analyse Critique des Pratiques de L’antibiothérapie en Elevages Avicoles, Thèse Médecine Veterinary. Université Mentouri de Constantine, République Algérienne Démocratique et Populaire, Algeria. p100.

32. Ngoune, L.T., Tanedjou, K.S. and Mbofung, C.M.F. (2009) Impact of antibiotics use on the susceptibility of pathogenic bacteria of hens in the Ngaoundere city. Cameroon J. Exp. Biol., 5(2): 52-61.

33. Martel, J.L., Tardy, F., Sanders, P. and Boisseau, J. (2001) New trends in regulatory rules and surveillance of antimicrobial resistance in bacteria of animal origin. Vet. Res., 32(3-4): 381-392.

34. Sidibé, S., Traoré, A.B., Koné, Y.S., Fané, A., Coulibaly, K.W., Doumbia, A.B., Bamba, A. and Traoré, O. (2019) Antibiotic resistance of isolated Salmonella gallinarum strains in modern poultry farming in suburban areas in Mali. Rev. Elev. Méd. Vét. Pays Trop., 72(4): 1-5.

35. Apata, A., Attien, P., Traoré, G.S., Sina, H., Baba-Moussa, L. and Koffi-Nevrey, R. (2016) Antimicrobial resistance of potential pathogenic strains isolated from eggs produced by informal farms and sold in Abidjan, Ivory Coast. Afr. J. Microbiol. Res., 10(16): 542-551.

36. Mogenet, L. and Fedida, D. (1998) Rational Antibiotherapy in Poultry Farming. CEVA, Switzerland.

**********