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Poultry Farming Practices and Potential Biological Risks in Niamey, Niger

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A B S T R A C T

Poultry farming is an important economic activity practiced by the majority of Nigeriens, but its growth remains relatively fragile due to health aspects. The objective of this study is to assess breeding practices and potential microbiological risks in poultry farms in the Niamey region. To do this, a survey was conducted from June to October 2024. Samples of food, water and droppings were taken. The results of this study identify several poultry farming practices, including breeding, broiler farming, egg production and mixed strain farming. Although the majority of farms use organic cage and feed farming. In fact, 60% do not comply with isolation standards and do not monitor internal movements. Regarding input management, few farms control the feeding of chicks. As for bedding, 60% of farms have set it up and 80% clean the feeders daily. However, more than half of the corpses are occasionally collected and cremated. The results of the farm analysis show a high level of microbial contamination of the food, with *E. coli* measured at $1.40\pm2.20.10^6$ CFU/g and fecal coliforms at $4.23\pm0.78.10^6$ CFU/g, exceeding the standard of 99 CFU/g. Water samples also revealed high levels of *E. coli* at $2.72\pm3.14.10^4$ CFU/g and CF at $4.80\pm5.54.10^6$ CFU/g, exceeding the standards of 0 CFU/g for CT and 50 CFU/g for CF. The cloaca swabs show $4.13\pm4.77.10^7$ CFU/g for *E. coli* and $3.63\pm4.19.10^6$ CFU/g for CF, while the droppings samples show $5.37\pm0.10.10^7$ CFU/g for *E. coli* and $2.49\pm4.32.10^8$ CFU/g for CF, exceeding the standard of 510^3 CFU. *Salmonella* spp. contamination is observed in 60% of farms. This underscores the importance of raising farmers' awareness of biosecurity measures and microbiological risks related to poultry farming and the development of microbiological standards in poultry farms.

Introduction

Poultry farming is a pillar of food and economy in West Africa, where poultry production is growing steadily. In Niger, data compiled by the National Institute of Statistics indicates that poultry population numbered more than 9.4 million heads in 2021 (INS, 2023). Poultry farming is mainly practised in rural areas using rudimentary livestock systems (Bebay, 2006). With the population explosion, poultry farming has become an urban or peri-urban activity. As a result, this activity is practiced by all social strata with the aim of improving their socio-economic living conditions (Vidogbena *et al.,* 2010). Despite this undeniable importance, poultry farming encounters difficulties related to management methods, health safety procedures and avian health problems, as well as the implementation of biosecurity (Kouadio *et al.,* 2013; Bansé *et al.,* 2015; Brah, 2015). Several factors influence the health status of the animals, namely: feed, drinking water, housing conditions and farm management (AMCRA, 2013). The farm can be contaminated through visitors or staff moving from one barn to another. The application of good husbandry practices keeps animals healthy and helps to improve their performance. Biosecurity measures must be taken on poultry farms according to the level of risk of contamination. These biosecurity measures are sanitary barriers that aim to prevent the introduction and spread of diseases or pathogens in livestock farming (Drouin, 2000; AMCRA, 2013). To reduce the risk factors or emergence of avian diseases and ensure a healthy poultry production system, it is necessary to evaluate the biosecurity practices put in place on farms with a view to improving them. It is therefore within this framework that our work is situated. The objective of this study is to assess breeding practices and potential microbiological risks in poultry farms in the Niamey region.

Materials and Methods

Study Framework

This study was carried out in the Urban Community of Niamey, located between latitude 13°28' and 13°35' North and longitude 2°03' and 2°10' East, with an estimated population of 1,492,414 inhabitants. Five urban and peri-urban poultry farms were the subject of this study (Farms A, B, C, D & E). The selection of this area is justified by the presence of many farms on the borders of the region, characterized by high poultry consumption and production, as one of the poultry regions of Niger. The accessibility of the sites guided the choice of farms, similar to the method used by Bitty (2013) for his surveys on health management in Dakar. However, herders' distrust of tax officials made it difficult to gather information.

Study Type

It is a descriptive cross-sectional, consists of two stages: a survey on the farms, using a data collection sheet and microbiological analyses.

Conduct of the Investigation

To carry out this activity, a questionnaire were drawn up, sent to the managers or owners of the farms in order to collect information and make observations. An interview was conducted using a survey sheet containing questions on socio-demographic factors, organizational characteristics, biosecurity measures, animal feeding and watering, and the assessment of the level of contamination with pathogenic germs in poultry reared.

Sample Collection and Transport

Collection: During this stage, samples from poultry farms that had granted access were collected. A cooler was used to keep the samples cool for analysis.

Microbiological Analysis Sampling

Samples were collected on the day or the day before each handling. On farms with many subjects, two cages were randomly selected for sampling, while in those with fewer subjects, sampling was based on type. Feed and samples of poultry droppings and water were taken in sterile boxes. Two (2) vent swabs were also taken per farm. A fact sheet was associated with each sample. All transported in a cooler containing ice at 4°C to the microbiology laboratory of the Abdou Moumouni University in Niamey.

Microbiological Analysis

The microbiological analysis was devoted to the search for and enumeration of two categories of germs. Firstly, the hygiene indicator germs, which are total coliforms, faecal coliforms and *Escherichia coli*. Second, pathogenic germs, including *Salmonella* spp.

Preparing the Stock solution

The ISO 6887-V08-010-6 (2013) method was used for the preparation of the stock solutions. Thus, 10 g of each sample was weighed and poured into a vial containing 90 ml of EPT after being crushed. The filtrate obtained was homogenized and curved for 60 minutes under agitation. This solution is used to make a series of decimal dilutions.

Total Coliform Counts

Total coliform counts were performed in accordance with ISO V 08-015 (1991) and ISO 4832. Inoculation was carried out on MacConkey agar, using 10^{-2} and 10^{-3} dilutions. For each dilution, 0.1 mL was aseptically inoculated into petri dishes. Incubations were conducted at 37 °C for 24 hours. The colonies observed, having a bright red to pinkish color, were then counted.

Fecal Coliform Counts

Fecal coliforms were isolated and quantified on Mac Conkey agar in accordance with ISO V 08-017 (1996). A volume of 0.1 mL of dilution 10-3 was aseptically inoculated into petri dishes. The dishes were then incubated for 24 hours at 44 °C, and only colonies with a bright red to pinkish colour were considered for the final count (Almou, 2020).

Escherichia coli Counts

The E. *coli* test was performed on EMB (Eosine Methylene Blue) medium using the ISO 3811 method. The incubation of the petri dishes was done at 37°C for 24 hours. Green colonies with metallic sheen were counted.

Salmonella spp Search

The search for *Salmonella* was carried out in two stages: enrichment and isolation.

For enrichment, 0.1 mL of the sample pre-enriched in peptone water was added to a sterile tube containing 10 mL of Rappaport Vassiladis medium, followed by homogenization and 24-hour incubation at 37°C. For isolation, cultures of Rappaport Vassiliadis were inoculated on SS (Salmonella-Shigella) solid selective medium and then incubated for 18 to 24 hours at 37°C.

Reading and Interpretation

According to the French standard V 08-011, each box retained must contain a maximum of 300 colonies and at least 15 colonies. The number of micro-organisms per gram of the sample is calculated from the boxes retained at the level of successive dilutions by applying the formula below:

$$N = \frac{\Sigma C}{v(n1 + n2 * 0{,}1)d}$$

Σc = Total number of colonies counted in the boxes;

n1 = number of boxes counted from the first dilution;

n2 = number of boxes counted from the second dilution;

v = volume inoculated, generally 0.1ml;

D = dilution factor from which the 1st counts were made.

Method of statistical analysis

The data collected was recorded and analyzed in the EXCEL2013 spreadsheet to generate charts and tables. IBM SPSS statistics version 23 was used to calculate the means and standard deviations. The design of the questionnaires and the preparation of the document were done on Microsoft Word.

Results and Discussion

Characteristics of the Farms

This study revealed different farming practices: two farms specialize in breeding, one raises broilers, another focuses on laying hens (egg production) and the last raises mixed strains (layer and broiler). Of these farms, three (60%) practice cage farming, while another practices stray farming and another has modern buildings where the animals are reared in battery farms.

As far as feed is concerned, all farms manually provide organic compound feed (corn + other type) using specific materials. Poultry farms are protected by fencing, with two farms maintaining a distance of more than 50 metres between poultry houses to minimise the spread of disease, while others are located at a distance

of 3 metres between some poultry houses, accounting for (20%).

Data on biosecurity practices

The results show that three out of five farms (60%) do not comply with isolation standards. In addition, three of the farm managers say that there are no other farms nearby, while two maintain the opposite. The types of livestock farming in the vicinity are mainly those of sheep, goats, pigeons, dogs, rabbits, quails, guinea fowl and ducks. All farms are home to domestic and wild animals, as well as various insects and reptiles, such as cats, flies, margouillats and turtledoves.

The analysis also reveals that 60% of farms do not monitor movement within the farm, and although 40% do. As for the management of inputs, shows that three farms control the entry of chicks but not that of their feed or drink. As far as bedding is concerned, three out of five farms, or 60%, own and control it. Sanitation data indicate that two of the farms clean and disinfect after each strip (strip = species from the same lot), two others do it differently, while one farm before each strip with bleach as the primary disinfectant. It should be noted that 80% of farms clean and disinfect feeders daily. In addition, all farms conduct a hygiene inspection using a visual assessment. In addition, more than half (60%) of the corpses on farms are occasionally collected and cremated.

Results of Microbiological Analyses

Levels of water contamination by farm

The bioburden recorded in the study shows contamination levels for *E.coli* $2.72\pm3.14.10^4$ CFU/g and for CF at $4.80\pm5.54.10^6$ CFU/g. Farm A has a microbial load in CT of $5.45\pm6.29.10^6$ FU/g, in CF of $3.27\pm0.37.10^6$ CFU/g and *in E.coli* of $4.80\pm5.54.10^6$ CFU/g.

Farm D also has a high bioburden load. These values exceed the standards of 0 CFU/g for TCs and 50 CFU/g for CFs.

The analysis reveals no significant difference between the contamination standard and the different farms about TCs with a P-value of 0.164. However, there is a significant difference between the contamination standard and the different contamination indicator loads observed for CF and EC with P-values of 0.017 and 0.007, respectively.

Level of contamination of the feed according to the farm

The bioloads in the analyzed farms are high, with a load of $1.40\pm2.20.10^6$ CFU/g for EC and $4.23\pm0.78.10^6$ CFU/g for CF. Farm C has a CF load of $4.23\pm0.78.10^6$ CFU/g while Farm A has a high TC bioburden of $4.44\pm7.04.10^6$ CFU/g) and $1.40\pm2.20.10^6$CFU/g. *E.coli,* exceeding the standard of 99 CFU/g. No significant differences were observed between the standards and the different farms with P-values (0.254 et 0.712, respectively). However, there is a significant difference between the EC standard and the different contamination indicator loads of farms with values with a P-value of 0.031.

Contamination levels of manure samples by farm

The table shows that all measured bioburden levels are high, showing $5.37\pm0.10.10^7$CFU/g for *E. coli* and $2.49\pm4.32.10^8$CFU/g for CF. Farm A has the highest bioburden of total coliforms at $1.30\pm2.26.10^8$CFU/g, while Farm E has the highest bioburden of fecal coliforms at $2.49\pm4.32.10^8$CFU/g and *E. coli* at $5.37\pm0.10.10^7$CFU/g, the latter being higher than the standard of 510^3.

Concerning the TCs, the analysis reveals two homogeneous groups: farm A, B, C and D form group "a" while farm E belongs to group "b". For TCs, farms B, C and D are grouped in group "a" while farms A and E make up group "b". And *E. Coli* also has two groups with farm C belonging to two "ab" groups.

Contamination levels of vent swabs by farm

The recorded microbial loads are at $4.13\pm4.77.10^7$ CFU/g for *E.coli* while those for CF are at $3.63\pm4.19.10^6$CFU/g. Farm A stands out for having the highest bioburden in CF with $3.63\pm4.19.10^6$CFU/g. As for the E farm, it has high values in CT with $6.81\pm7.87.10^3$CFU/g and also in *E.coli* with $4.13\pm4.77.10^7$CFU/g, exceeding the standard of 1.10^4. Significant differences are noted between the standards and the different contamination indicator loads of the farms with respective values of 0.013; 0,021; 0.013.

The results of the study reveal that 100% of the managers of the farms surveyed have a higher level of education. These results are higher than those found by Dosso in 2014 in Côte d'Ivoire, i.e. 17% (Dosso, 2014). This high level of education allows managers to understand the meaning of biosecurity, its importance and the risks associated with its non-implementation. All farms are characterised by a specific type of breeding, but only 40% of them practice reproduction, which is considered more profitable and less risky.

Table.1 Characteristics of the farms

Characteristics	Frequency	Percentage (%)
Type of breeding		
Reproduction	2	40
Broiler chicken	1	20
Hens	1	20
Mixed strain	1	20
Hosting system		
Modern	1	20
Cage	3	60
Rambling	1	20
Food Distribution		
Manual	5	100
Types of food consumed		
Biological	5	100
Presence of fence		
Yes	5	100
No	0	0
Sealing of poultry house floors		
Yes	3	60
No	2	40
Distance between poultry houses		
+50m	2	40
3m	1	20
Side by side	2	40
Specificity of the equipment		
Yes	5	100
No	0	0

Table.2 Key Aspects of Poultry Farm Biosecurity

Characteristics	Frequency	Percentage (%)
Compliance with the building insulation standard		
Yes	2	40
No	3	60
Existence of other livestock in the vicinity		
Yes	2	40
No	3	60
Access for domestic and wild animals		
Yes	5	100
No		0
Traffic Control		
Yes	2	40
No	3	60
Input management		
Chick Starter		
Yes	3	60
No	2	40
Presence of litter		
Yes	3	60
No	2	40
Food Control		
Yes	2	40
No	3	60
Water Control		
Yes	1	20
No	4	80
Cleaning-disinfection		
Before each band	1	20
After each tape	2	40
Other (after the dirt has been observed)	2	40
Cleaning-disinfection of feeders		
Daily	4	80
Occasionally	1	20
Three main disinfectants used		
Bleach	2	40
Virunet, bleach and chlorine	1	20
Sleet, virunet, doxin-200	1	20
Other (disinfectant type)	1	20
Type of disinfectant		60
Powder	3	
Liquid	2	40
Hygiene assessment		
Naked eye	5	100
Outbound management		
Collecting Dead Bodies		
Daily	1	20
Group in a specific hole	1	20
Occasionally	3	60
Becoming of corpses		
Cremated	3	60
Buried	1	20
Other (consumed by workers)	1	20

Table.3 Level of Water Contamination by Farm

N°Farm	Load (CFU/g of water) of contamination indicators			
	CT	**CF**	***E. coli***	***Salmonella* spp**
Farm A	$5.45\pm6.29.10^{6\,a}$	$3.27\pm0.37.10^{6\,ab}$	$2.72\pm3.14.10^{4\,b}$	Not detected
Farm B	$2.47\pm4.57.10^{6\,a}$	$0.68\pm1.2.10^{5\,a}$	0	Not detected
Farm C	$2.23\pm3.81.10^{5\,a}$	$0.13\pm0.23.10^{6\,a}$	0	Presence
Farm D	$4.69\pm0.54.10^{6\,a}$	$4.80\pm5.54.10^{6\,a}$	0	Presence
Farm E	0	0	0	Presence
Norm	0	$50^{\,a}$		Absence/25g
P-value	0,164	0,017	0,007	

CT: Total Coliform, CF: Fecal Coliform

Table.4 Level of Feed Contamination by Farm

N° Farm	Load (CFU/g of food) of contamination indicators			
	CT	**CF**	***E. coli***	***Salmonella spp***
Farm A	$4.44\pm7.04.10^{6\,a}$	$2.12\pm5.19.10^{6\,a}$	$1.40\pm2.20.10^{6\,b}$	Not detected
Farm B	$2.05\pm4.18.10^{6\,a}$	$1.52\pm2.65.10^{6\,a}$	$0.17\pm 0.43.10^{6\,a}$	Not detected
Farm C	$2.87\pm5.96.10^{5\,a}$	$4.23\pm0.78.10^{6\,a}$	$0.12\pm0.33.10^{5\,a}$	Presence
Farm D	$1.49\pm2.59.10^{6\,a}$	$1.70\pm3.53.10^{6\,a}$	0	Presence
Farm E	$2.81\pm4.88.10^{6\,a}$	$1.06\pm2.57.10^{6\,a}$	0	Presence
Norm			$99^{\,a}$	Absence/25g
P-value	0,254	0,712	0,031	

CT: Total Coliform, CF: Fecal Coliform

Table.5 Contamination levels of manure samples by farm

N° Farm	Contamination indicator load (CFU/g droppings)			
	CT	**CF**	***E. coli***	***Salmonella spp***
Farm A	$1.30\pm2.26.10^{8\,a}$	$2\pm3,14.10^{8\,b}$	0	Not detected
Farm B	$1.21\pm2.10.10^{7\,a}$	$1.30\pm2.26.10^{7\,a}$	$1.13\pm1.97.10^{7\,b}$	Not detected
Farm C	$5\pm0.97.10^{6\,a}$	$7.31\pm1.18.10^{6\,a}$	$5.37\pm0.10.10^{7\,ab}$	Presence
Farm D	$5\pm8.43.10^{6\,a}$	$7.44\pm0.11.10^{6\,a}$	$2\pm3.27.10^{6\,a}$	Presence
Farm E	$4.43\pm8.10^{6\,b}$	$2.49\pm4.32.10^{8\,b}$	$1\pm2.10^{6\,a}$	Presence
Norm			$5000^{\,a}$	Absence/25g
P-value	0,00	0,01	0,010	

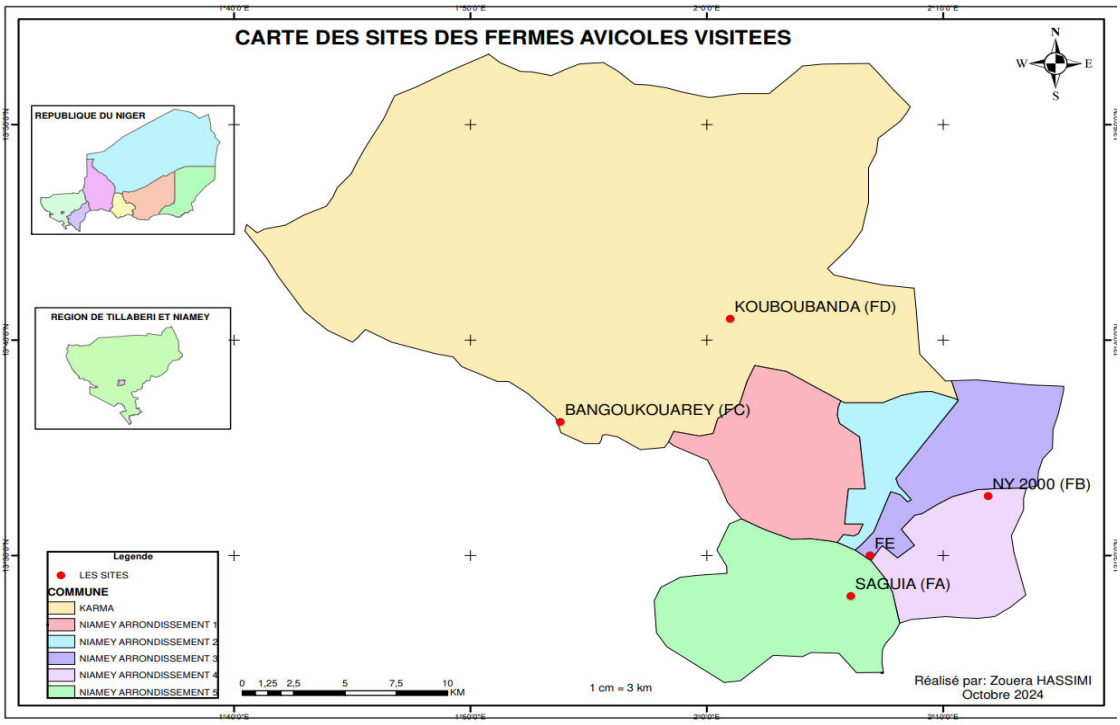
CT: Total Coliform, CF: Fecal Coliform

Table.6 Level of contamination of vent swabs by farm

N°Farm	Load (CFU/g swab) of contamination indicators			
	CT	**CF**	***E. coli***	***Salmonella spp***
Farm A	0	$3.63\pm4.19.10^{6\ b}$	0	Not detected
Farm B	$0.22\pm0.26.10^{4\ a}$	$1.13\pm1.31.10^{4\ a}$	0	Not detected
Farm C	$0.34\pm0.40.10^{4\ a}$	$6.81\pm1.10^{4\ a}$	0	Presence
Farm D	$1.73\pm2.00.10^{6\ b}$	$1,38\pm1,60,10^{6\ ab}$	0	Presence
Farm E	$6.81\pm7.87.10^{3\ a}$	$2.27\pm2.62.10^{3\ a}$	$4.13\pm4.77.10^{7\ b}$	Presence
Norm			$104^{\ a}$	Absence/25g
P-value	0,013	0,021	0,013	

CT: Total Coliform, CF: Fecal Coliform

Figure.1 Location of the study area (Hassimi, 2024)



In terms of accommodation, only 20% have a modern system, well below the 98.3% reported by N'Guessan (2009) in Côte d'Ivoire, i.e. this low rate could be attributed to a lack of financial resources and the perception that modern accommodation is not essential.

This study reveals that all (100%) of farms receive and distribute organic feed manually, similar results to those of Oulon (2010) in Senegal, where the rate was 96%. Organic food is crucial for avian nutrition, according to the WHO, (2013), and must contain all the necessary elements for optimal growth.

For the temperature of the premises, only 20% of the farms surveyed maintain the ambient temperature, which is lower than the 29.4% reported by N'Guessan (2009) in Côte d'Ivoire. This could be attributed to a lack of financial resources for high-tech facilities. On the other hand, all farms (100%) have a protective fence around their buildings. This is higher than the results reported by N'Guessan (22.9%) (2009) in Côte d'Ivoire and Amadou (2016) in Mali who found 15.22%. However, our results are in line with the standards outlined by the FAO (2024) on biosecurity measures. For our study, all farms have fences. Those in charge are aware of the

importance of a fence for a livestock building. Regarding soil tightness, 60% of farms have waterproof soils, a rate lower than that of N'Guessan (2009) in Côte d'Ivoire, (73.1%), probably due to battery farming practices.

The distance between poultry houses is an important element in preventing the spread of germs: less than half (40%) are located more than 50 metres away, unlike those reported by N'Guessan (2009) in Côte d'Ivoire with 10.9% for a distance of at least 20 metres.

The farms use proprietary materials to prevent contamination. One point or all farms (100%) comply with this measure, a similar observation to that of N'Guessan (2009) in Côte d'Ivoire with a rate of 96.6%.

The evaluation of biosecurity measures focuses on three components, including isolation, which is essential to protect poultry from pathogens (FAO, 2024). However, 60% of farms do not comply with this measure, with 40% of managers indicating the proximity of other farms, a rate higher than that of N'Guessan (15.1%) (2009) in Côte d'Ivoire. These rates do not meet the standards set by the FAO (2024). All farmers (100%) say that wild or domestic animals have access to their farms. This finding is similar to that reported by Amadou (2016) in Mali, but differs from N'Guessan (2009). The lack of effective systems around farms could explain this situation. Despite these shortcomings, the results for segregation remain acceptable.

On-farm input management combines control of chick entry, feed, water supply and bedding. According to the results, 60% of farms control the entry of chicks, a rate lower than that reported by N'Guessan (2009) in Côte d'Ivoire.

In Niger, the state has a system for tracing chicks, which are often quarantined on arrival. Regarding the feed given to the chicks, nearly 40% of farms carry out a bacteriological analysis of the feed in accordance with the recommendations of the FAO (2024) and Kaboret (2007b). However, 80% of farms do not treat the water supplied to the subjects, contrary to the good husbandry practices described by the FAO (2024), a failure attributed to financial constraints.

As for bedding management, 60% of the farms surveyed carry out a check, a figure lower than the rate of 92% observed by Oulon (2010) in Senegal. Only 40% of farms clean and disinfect the bedding after each flock, contrary to the study by Oulon (2010) in Senegal, where all farms followed this procedure. In contrast, 80% of farms clean and disinfect their feeders and waterers daily, mainly using bleach, a cheap and widely available disinfectant.

Regarding the type of disinfectant, three (3) of the 5 farms use powdered disinfectants, in accordance with the practices reported by N'Guessan (2009) in Côte d'Ivoire and Abdelkader Et Abdenour (2019) in Algeria. Regarding the hygiene assessment, all farms carry out a visual inspection. However, only 60% collect dead bodies daily, which is not in line with good practices, described by (FAO, 2024), which states that dead bodies should be cremated or buried. Cremation of corpses is the most common method, in line with the results obtained by Oulon (2010) and FAO standards.

The results of bacteriological analyses highlight the presence of germs such as *Salmonella spp*, *E. Coli*, and others (CT, C) contrary to the study by Abdelkader and Abdenour in Algeria (2019) which identified additional germs *Staphylococcus aureus,* and *Clostridium perfringens.*

The study used four types of samples from different farms (feed, water, vent swab, and droppings). Water, although essential to life, represents a risk of contamination. This study reveals a high bioburden with Farm A having the highest total coliform (TC) load at $5.45\pm6.29.10^6$ CFU/g, fecal coliform (CF) at $3.27\pm0.37.10^6$ CFU/g, and *E. Coli* at $2.72\pm3.14.10^4$ CFU/g, exceeding the established standards (0 for CT and 50 for CF). These results are at odds with the recommendations of El Hraiki *et al.,* (2021) in Morocco, which state that total and faecal germs should not exceed these limits. The results of the analysis of the cloaca and feed samples reveal high microbial loads on several farms. Farm D has a TC bioburden of $1.73\pm2.00.10^6$, while Farm A has a high CF load of $3.63\pm4.19.10^6$. In addition, Farm E shows a significant *E.coli* load of $4.13\pm4.77.10^7$, with average levels exceeding the standard of 104, in contradiction with the microbiological criteria of the FIA (2018). For food samples, Farm A recorded a TC load of $4.44\pm7.04.10^6$, while Farm B had high levels of CF ($4.23\pm0.78.10^6$) and EC ($5.8\pm8.2.10^6$), exceeding the standard of 99 CFU/g. Farm B is particularly contaminated with CT ($6.78\pm6.69.10^4$ CFU/g) and E. coli ($5.8\pm8.2.10^6$ CFU/g), while Farm A is the most affected with CF ($7\pm9.89.10^7$ CFU/g). These results are inconsistent with the standard

established by CNERNA and DUNOD (1998), where the number of colonies must not exceed 99 CFU/g.

The results obtained reveal high microbial loads, particularly in the manure. Farm A has the highest bioburden of TC (1.30±2.26.10^8CFU/g) and Farm E has critical levels of fecal coliforms (2.49±4.32.10^8CFU/g) and *E. coli* (5.37±0.10.10^7CFU/g), the latter well exceeding the regulatory standard of 5$10^3$CFU/g. These results are higher than those of Boko *et al.,* (2015) in Benin, who had noted an *E. coli* load of manure of 15,10^4 CFU/g, well above the thresholds recommended by EC Regulation 1774/2002 and NF U 44-051 (5,103/g and 102/g respectively). Regarding salmonella spp, which is a major public health concern because of foodborne illnesses, 60% of the farms studied have contamination, a figure significantly higher than the 28.5% reported by Cardinale (2001) in Senegal. These results also exceed the recommendations of the FIA (2018), which states that the presence of salmonella spp should not be detected. These data raise questions about husbandry practices due to the high microbial loads observed

In conclusion, these observations on poultry farming practices combined with the results of microbiological analyses show that, from a hygienic point of view, poultry farming practices are still unsatisfactory. These practices increase the risk of increased infections, with consequences for the health and performance of the animals.

Author Contributions

Alio Sanda Abdel-Kader: Investigation, formal analysis, writing—original draft. Issifi Kollo Abdoulkader: Validation, methodology, writing—reviewing. Hassimi Adamou Zouéra:—Formal analysis, writing—review and editing. Almou Abdoulaye Alio: Investigation, writing—reviewing. Abdoulaye Ousmane Boubacar: Resources, investigation writing—reviewing. Sabo Seini Haoua: Validation, formal analysis, writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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