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Research Article

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Impact of Mbeubeuss Landfill on the Microbiological and Chemical Quality of Broiler Chickens Produced in Malika (Senegal)

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ABSTRACT

A study on the impact of Mbeubeuss landfill on the microbiological and chemical quality of broiler chicken carcasses produced in the commune of Malika has been carried out in Dakar. It involved a sample of 100 chickens collected from nearby farms. Research on the various contaminants has been conducted in accordance with standard methods. Results show that: On the microbiological quality of samples, 98% of carcasses are contaminated by aerobic micro-organisms at 30°C (54% at a distance of less than one km and 44% at a distance of more than one km from Mbeubeuss landfill); 93% by Escherichia coli (53% and 40%); 25% by Staphylococcus aureus (18% and 7%); 94% by Clostridium perfringens (54% and 40%); 7% by Salmonella spp. (2% and 5%). Regarding the microbiological standards, 89 of the 100 chicken carcass samples studied are satisfactory. The 11 unsatisfactory carcasses include 3 with excess Escherichia coli (3 at a distance of less than 1 km), 1 with excess Staphylococcus aureus (at a distance of less than 1 km) and 7 with salmonella spp. (2 at a distance of less than 1 km and 5 at a distance of more than 1 km).

As for the chemical quality of the chickens, 68% of carcasses are contaminated with Mercury (40% at a distance of less than one km and 28% at a distance of more than one km); 0% contamination with Lead and 0% contamination with Cadmium. 20% of the carcasses are deemed unsatisfactory due to mercury contamination.

When the quality of drinking water is taken into account in the variation of microbiological and chemical quality of broiler chickens, all the samples deemed unsatisfactory are coming from farms where the well is the source of drinking water for birds.

Keywords: Broiler Chicken, Well Water, Chemical and Microbiology Quality, Mbeubeuss Landfill, Senegal

Introduction

Mbeubeus landfill was established in 1968 (in Pikine/Dakar/Senegal) and receives 475,000 tonnes of solid waste per year. Due to the lack of urbanization of the area and the growing population, numerous poultry farms have settled around the landfill. The shortage of drinking water has pushed farmers to water their poultry from wells.

The Dakar landfill, like all landfills, presents risks of contamination of ground and surface water, soil and air pollution, which have a direct impact on human and animal health and productivity, including poultry.

Studies by SONKO 2022 and Pesticide Action Network (PAN) africa in 2020 have respectively demonstrated that the sudden deaths of the animals could have been caused by recycled rice from the landfill resulting in the presence of dioxins, biphenylchlorates and hexachlorobenzene in the eggs (11 eggs).

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These studies show the harmful effects of the fumes emanating from Mbeubeuss landfill.

Considering the distance separating the landfill from the farms and the use of well water, can we say that the landfill has an impact on the microbiological and physicochemical quality of poultry produced at Malika in Department of Keur Massar?

To answer this question, EISMV's Zootechnics and Food Hygiene (HIDAOA) departments in Dakar, in partnership with the Laboratory for Wastewater Treatment, carried out the following study. The purpose of this study is to help improve the hygienic and chemical quality of these foodstuffs by comparing the level of contamination in broiler chickens with distance and source of watering.

Material and Methods

Work Site and Study Period

This study took place in the districts of Malika which is an area where most of the poultry farms are located and is approximately 1 kilometer from the Dakar household waste dump. The survey involved 24 poultry farms in the district.

Sampling

100 carcasses of 1.2 kg chickens have been randomly sampled from 24 pilot farms in Malika (54 at a distance of less than 1 km and 46 at a distance of more than 1 km from the landfill, then 66 have been watered with well water and 34 with SDE water). Samples have then been sent to the food microbiology laboratory of the Dakar Veterinary School (EISMV). Of the 100 carcasses, 25 have been sent to the Insttitute of Food Technology laboratory (ITA-Dakar) for chemical analyses.

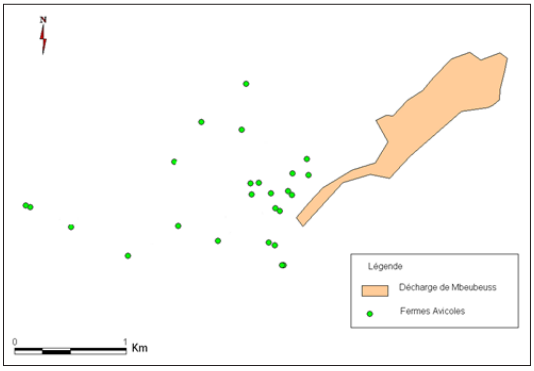

Figure 1: Location of the 24 poultry farms sampled around the landfill [1]

Bacteriological Analyses

For bacteriological analyses, the techniques used are those recommended by the French Standardization Association [2].

Flora Searched for

Cultivation methods and normative references for each type of germ are given in Table 1.

Table 1: Flora searched for, cultivation methods and normative references [3]

Flora searched for	cultivation environnement	Incubation			References Standards
		Température (°C)	Duration (h)	Atmosphere	
Aerobic microorganisms at 30°C	Standard agar (PCA: plate count agar)	30°C	48-72	Aerobe	ISO 4833-1
Heat-tolerant coliform	VRBL agar	44°C	24	Aerobe	NVF 08-060
Escherichia coli	PTX agar	44°C	18-24	Aerobe	NFV 08-053
Staphylococcus aureus	Baird-parker (BP) Brain heart infusion broth Rabbit Plasma	37°C	48 20/24 24	Aerobe	NFV O8-57
Clostridium perfringens	Cycloserine tryptose-sulfite agar (TSC) Thioglycolate liquid	37°C	20 24	Anaerobe	NFXPV 08-61
Salmonella spp.	Rappaport vassiladis (RV) MKKTTn broth Rambach agar Hektoen agar Nutrient agar (NA)	37°C	18-24 48 24	Aerobe	ISO 6579

Interpretation Methods

Results of microbiological analyses were captured in an excel spreadsheet for graphic presentation, then transferred to Epi-info for average and frequency calculation (LAURA et al., 2024). These various results have been interpreted in accordance with French regulations, see Table 2.

Chemical Analysis

Dosage Methods (Hg, Pb, Cd)

The techniques used include flame spectrophotometry (Pb, Cd) and cold vapor atomic absorption spectrophotometry (Hg) [5].

Table 2: Microbiological criteria applicable to raw carcasses of poultry meat with contaminated skin [4]

Flora	Criterion of non-compliance in CFU/g
F.M.A.T	5.10^6
Escherichia coli	10^4
Staphylococcus aureus	10^2
Clostridium perfringens	3.10^2
Salmonella spp.	Absent in 25g deep or after cauterization

Interpretation Method

Non-compliance criteria are those of Lahallec [6,7]:
Hg= 0.011mg/kg of chicken, Pb= 0.5mg/kg and Cd= 0.2mg/kg.

Results and Discussion

Microbiological Quality of Broiler Chickens' Carcasses

We will highlight two parameters: the distance between the farms and the landfill, and the source of water for the poultry.

Carcass Contamination Depending on Distance (Farms and Landfill)

Table 3: Impacts of distance between farms and Mbeubeuss landfill on microbiological quality of broiler chickens

Flora searched for	Distance between farms and landfill				Results
	<1km		> 1 km		
	Number	Proportion (%)	Number	Proportion (%)	
Echerichia coli	50 2 2	92.6 3.7 3.7	44 1 1	95.7 2.2 2.2	S A NS
Faecal coliforms	53 1 0	98,1 1.9 0	46 0 0	100 0 0	S A NS
Sulphide-reducing anaerobes	47 7 0	87 13 0	43 3 0	93.5 6.5 0	S A NS
Total aerobic Mesophilic flora	42 12 0	77.8 22.2 0	36 10 0	78.3 21.7 0	S A NS
Staphylococcus	54 0 0	100 0 0	45 0 1	97.8 0 2.2	S A NS
Salmonella	52 2	96.3 3.7	41 5	89.1 10.9	A P

Taking into account the impact of distance between farms and landfill Mbeubeuss on microbiological quality of broiler chickens, this revealed contamination of the samples tested at various level depending on the microbiological parameters. It is worth noting that of the 11 non-compliant samples, 3 have excess Escherichia coli in all poultry from farms within 1 km, 2 and 5 samples have salmonella spp. At a distance of less than 1 km and more than 1 km respectively, 1 sample has excess staphylococcus aureus in farms located at more than 1 km (figure2). Apart from salmonella, which are germs common to livestock farming, all other germs - E. coli, staphylococci and clostridium - come from farms close to the landfill. This means that the landfill certainly has an influence even though it's a very small one.

Contamination of Carcasses Depending on the Watering Source of the Farms

Taking into account drinking water as a factor in the variation of results is edifying (Table 4).

Table 4: Effects of drinking water source on the microbiological quality of broiler chickens around Mbeubeuss landfill

Flora searched for	Source of drinking water				Results
	< 1 km		> 1 km		
	Number	Proportion (%)	Number	Proportion (%)	
Echerichia coli	62 1 3	93.9 1,5 4.5	32 2 0	94.1 5.9 0	S A NS
Faecal coliforms	66 0 0	100 0 0	33 1 0	97.1 2.9 0	S A NS

Sulphide-reducing anaerobes	65 1 0	98.5 1,5 0	25 9 0	73.5 26.5 0	S A NS
Total aerobic mesophilic flora	59 07 0	89.4 10.6 0	19 15 0	55.9 44.1 0	S A NS
Staphylococcus	65 0 1	98.5 0 1,5	34 0 0	100 0 0	S A NS
Salmonella	62 4	93.9 6.1	31 3	91.2 8.8	A P

As for the contamination of carcasses depending on the source of drinking water, 11 carcasses were deemed unsatisfactory, including 8 have been in contact with well water (3 for excess Echerichia coli, 1 for excess Staphylococcus aureus and 4 for excess Salmonella) against 3 that have been in contact with tap water (3 for excess Salmonella) (figure 2).

The distribution of flora by contamination class helped to compare the results obtained with reference criteria, and thus to assess the cleanliness of the analyzed sample. We classify them into two main categories (Conforming= satisfactory+ acceptable, when the value is less than or equal to the reference criterion, and non-conforming when the value is higher than the criterion). As a result, 86p100 of the carcasses studied were compliant against 11p100 non-compliant.

With the exception of salmonella, which are quite common germs in poultry farming, all samples deemed unsatisfactory for both Escherichia coli and staphylococci come from farms where the well is the source of drinking water. These results, which confirm the technical parameters previously found, incriminate drinking water in the deterioration of poultry productivity and product quality, and raise a public health issue [8].

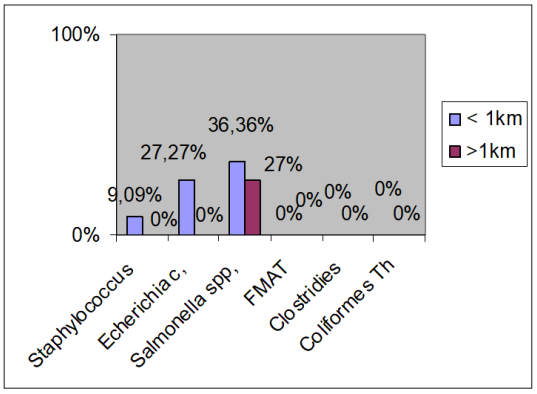

Figure 2: Proportion of non-compliant flora in the watering source

However, these results are better than those of Tall, who worked on the microbiological quality of broiler chickens in a modern slaughterhouse. This is probably due to the monitoring of our samples, and certainly to the conditions under which we prepared the poultry ourselves (FERNANDES et al., 2016) [9].

Chemical Quality of Broiler Chicken Carcasses

Taking into account our two aspects, that are the impact of distance between the farms and the landfill, and the impact of drinking water.

Table 5: Impacts of distance between the farms and Mbeubeuss landfill on the chemical quality of chickens

Heavy metals searched for	Distance between farms and landfill				Results
	< 1 km		> 1 km		
	Number	Proportion (%)	Number	Proportion (%)	
Mercury	11 4	73.3 26.7	8 1	88.9 11.1	S NS
Lead	15	100	9	100	S
Cadmium	15	100	9	100	S

Broiler chicken samples were lead and cadmium free. The results showed also that 26.7 p100 of the samples contain at least traces of mercury (Table 5). The presence of mercury in broiler can be explained by the fact that mercury is naturally occurring chemical compound. Indeed, according to European Food Safety Authority, it can find present at various stages in the environment, in soil, water and the atmosphere. It can also occur as residues in food because of their presence in the environment, as a result of human activities such as farming, industry or from contamination during food processing [10]. It is necessary to point out that the presence of mercury in broiler chickens is a public health issue, due its accumulation in the body can lead the harmful effects in over time. The findings of this study are therefore worrying insofar as; in developing countries, the poultry meat is mainly consumed for economic reasons, as it costs less than others meats [11].

By contrast, a comparison of the chemical quality of broiler chickens depending on distance from the landfill revealed higher contamination in the vicinity of the landfill (26.7p100) than in distant farms (figure 3). This probably means that the landfill has an influence on nearby poultry farms.

When the analysis takes into account the source of drinking water (Table 6).

Table 6: Impacts of the drinking water source on the chemical quality of broiler chickens produced in the vicinity of Mbeubeuss landfill

Heavy metals searched for	Source of drinking water				Results
	Well Water		Public water supply (SDE)		
	Number	Proportion (%)	Number	Proportion (%)	
Mercury	14 5	73.7 26.3	5 0	100 0	S NS
Lead	15	100	9	100	S
Cadmium	15	100	9	100	S

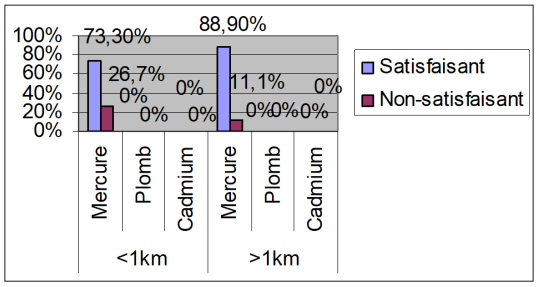

Figure 3: Proportion of non-compliant heavy metals depending on distance

We noted that all the polluted carcasses were those from broiler chickens watered with well water, representing 26.3p100 (Table 6). Higher contamination depending on distance was observed in well water from farms located less than 1km from landfill (Figure 4).

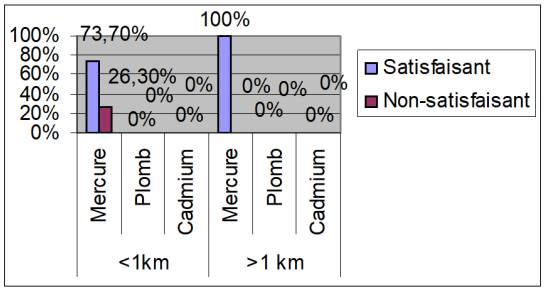

Figure 4: Proportion of non-compliant heavy metals in drinking water

We noted that all the polluted carcasses were those having been watered with well water, representing 26.3p100. Whatever the type of parameter taken into account, drinking water clearly plays an important role in the contamination of poultry products. The high presence with mercury (Table 6) confirms the major role played by well water in the poor microbiological and chemical quality of broiler chickens in the vicinity of the landfill (HAMED et al., 2018) [12-17].

Conclusion

The purpose of this study was to assess the impact of the landfill on the microbiological and physicochemical quality of a batch of broiler chickens produced in Malika. Regarding the microbiological quality: 86% of carcasses are fit for consumption and 11% are non-compliant. As for the chemical quality, 79.9% of carcasses are fit for consumption and 20.1% are non-compliant.

The microbiological quality of broiler chickens is highly satisfactory. The distance between the farms and the landfill has no clear influence on this parameter. By contrast, with the exception of salmonella which are the most common pathogenic microorganisms in poultry farming, all broiler chickens of unsatisfactory quality for both E. coli and staphylococci come from farms where wells are the source of drinking water for birds. Although mercury-contaminated chickens are more numerous around the landfill, the affected chickens are all from farms with no urban water supply.

Our results show that water plays a major role in the contamination of poultry carcasses.

We therefore call on the authorities to provide the populations of Malika with easier access to the public water supply network in order to find appropriate solutions to the poor performance of the poultry industry around the landfill.

Declaration of Competing Interest

No conflict of interest declared in the submission of this manuscript and its publication has been approved by all authors. I state on behalf of my co-authors that the work described has not been published previously, and it is not under consideration for publication elsewhere.

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