



## **High Carrying Rate of Extended-Spectrum Beta-Lactamase (ESBL) Producing Enterobacteriaceae by Slaughterhouse Workers in Lomé, Togo in 2019**

**Amivi Mawussi Godonou<sup>1,2</sup>, Fifonsi Adjidossi Gbeasor-Komlanvi<sup>3,4</sup>,  
Novissi Tsogbale<sup>2</sup>, Fiali Lack<sup>2,3</sup>, Sika Dossim<sup>2,3</sup>, Komla Batassé Batawui<sup>5</sup>,  
Yaovi Agbekponou Ameyapoh<sup>1</sup>, Koumavi Ekouevi<sup>3,4</sup>,  
Anoumou Yaotsè Dagnra<sup>2,3</sup> and Mounerou Salou<sup>3,6\*</sup>**

<sup>1</sup>*Ecole Supérieure des Techniques Biologiques et Alimentaires, University of Lomé, Togo.*

<sup>2</sup>*Teaching Hospital Sylvanus Olympio, Lomé, Togo.*

<sup>3</sup>*Faculty of Health Sciences, University of Lomé, Togo.*

<sup>4</sup>*Faculté des Sciences de la Santé (FSS), Département de Santé Publique,  
Université de Lomé, Togo.*

<sup>5</sup>*Livestock Direction, Lomé, Togo*

<sup>6</sup>*Teaching Hospital Campus, Lomé, Togo*

### **Authors' contribution**

*This work was carried out in collaboration among all authors. Authors MS, KE, KBB, AA and AYD designed the study. Authors FAGK and KE performed the statistical analysis, AMG, MS wrote the protocol, and wrote the first draft of the manuscript. Authors AMG, NT and FL managed the analyses of the study. Authors AMG, MS and SD managed the literature searches. All authors read and approved the final manuscript.*

### **Article Information**

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### **ABSTRACT**

**Introduction:** Extended-spectrum beta-lactamase-producing Enterobacteriaceae (ESBL) represent a real public health concern because of their spread. The role of agri-food chains in transmitting of digestive ESBL-producing bacterial strains in the community, was demonstrated but little work was

\*Corresponding author: E-mail: [mounerous@gmail.com](mailto:mounerous@gmail.com), [msalou@univ-lome.tg](mailto:msalou@univ-lome.tg);

done in our settings (Togo, west Africa). The aim of this study was to estimate the rate of digestive carrying ESBL producing enterobacteriaceae in slaughterhouse workers in Lomé, Togo.

**Material and Methods:** This was a cross-sectional study carried out in three slaughterhouses in Lomé. Fresh stools of 60 slaughterhouse workers and socio-demographic data were collected during the period of September to October 2019 after obtaining the consent of each participant. The bacterial strains of interest were isolated on the selective medium Purple Bromocresol + Ceftazidime at 6µg/l. Uriselect® and API 20E media were used for identification. Antibiotic susceptibility test was performed in Mueller-Hinton agar plate diffusion method (Kirby Bauer technic) and according to CASFM-EUCAST recommendations.

**Results:** The digestive carriage rate of ESBL producing enterobacteriaceae among professionals of three slaughterhouses of Lomé was 80% (n=48/60). *Escherichia coli* was the main bacteria 78.2% (n = 43/55) followed by *Klebsiella pneumoniae* 16.4% (n = 9/55) and *Enterobacter cloacae* 5.4% (n = 3/55). The antibiotic profile of ESBL producing enterobacteriaceae showed resistance to Amoxicillin + Clavulanic Acid (26%), Ticarcillin + Clavulanic Acid (86%), Piperacillin + Tazobactam (14%), Cefoxitin (7%) Ciprofloxacin (63%), Levofloxacin (49%), Nalidixic Acid (42%), Chloramphenicol (33%), Gentamicin (21%), Sulfamethoxazole-Trimetoprim (93%). These bacteria were 100% sensitive to Imipenem, Ertapenem, Amikacin and Fosfomycin.

**Conclusion:** This study revealed a very high carriage rate of ESBL producing Enterobacteriaceae among Slaughterhouse Workers in Lomé. It confirmed the major potential role of the agri-food chains in the spread of ESBL producing bacteria in the Community.

**Keywords:** Digestive carrying ESBL producing bacteria; workers; slaughterhouse; Lomé.

## 1. INTRODUCTION

Over the past decade, antimicrobial resistance in Enterobacteriaceae has increased dramatically worldwide. This situation is mainly due to an increased prevalence of enterobacteriaceae producing extended spectrum β-lactamases (ESBLs) [1]. When a single bacterium is resistant to more than one antibiotic it is said to be multidrug-resistant. The emergence of multi-drug resistant bacteria (MDRBs), in particular the enterobacteriaceae producing β-extended-spectrum lactamase (ESBL), is a concerned phenomenon in developing countries [2].

Extended-spectrum β-lactamases (ESBLs) have been detected in meat samples and transmission of ESBLs from livestock to humans through the food chain has been suggested [3,1,4,5]. ESBL-producing Enterobacteriaceae can be transferred from animals to humans through food or direct contact [6,7]. Direct contact with livestock mainly occurs in an occupational setting. In farmers, carriage of ESBL-producing Enterobacteriaceae is associated with the presence of ESBL-producing Enterobacteriaceae in animals [6,7,8].

Slaughterhouse workers might also be occupationally exposed to ESBL-producing Enterobacteriaceae. Depending on the job task, slaughterhouse workers have frequent contact with live animals, animal carcasses or animal products [9].

Studies have shown that one of the risk factors for the acquisition of extended spectrum beta lactamase (ESBL)—producing organisms is the abuse of antibiotics in poultry production [10]. Globally, there have been an increase in the challenges related to treatment of human and animal bacterial infections attributed to the development of antimicrobial resistance [11]. Resistance to commonly used antibiotics has major socioeconomic and public health implications.

The socioeconomic implications of AMR include increased cost and duration of treatment while the public health implications include decreased ability to treat common infections resulting in increased human suffering and ultimately death [12-14].

The possibility of antimicrobial resistance genes circulating among humans, animals and the environment constitutes a direct threat to public health. This is why it is critical to develop new approaches and institute strict control measures in accessing and using antimicrobials in humans and animals [15].

A few rare studies in Africa have investigated the fecal carriage of ESBL-producing enterobacteriaceae in the community and in hospitalized patients [16,17]. In Senegal, Michaud *et al.* in 2014 studied the ESBL carriage among workers and pigs [18]. Nevertheless,

carrying among slaughterhouse workers is poorly described.

In Togo, authors have described the phenomenon of bacterial resistance due to ESBLs in the hospital environment without addressing the carrying of ESBLs in the agro-food chain [19,20].

The purpose of this study is to estimate the prevalence of ESBL-producing Enterobacteriaceae carriage among workers in three slaughterhouses in Lomé.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

Our study was undertaken in three slaughterhouses in Lomé, the capital city of Togo (west Africa), which was located in the south-west of the country along the coast of the Gulf of Guinea with an area of 90 Kmsquare. It has 1,477,660 inhabitants according to the 2010 census.

The slaughterhouse in the port area ONAF (National Office of refrigerated slaughterhouse of Lomé) was located in district II of Lomé. The slaughter areas of Agoè-Zongo and Gbossimè were located in the Agoè district and district V of Lomé respectively.

The samples were analyzed at the microbiology laboratory of Sylvanus Olympio Teaching Hospital of Lomé.

### 2.2 Study Design

This was a cross-sectional study that took place from 1<sup>st</sup> September to 31<sup>th</sup> October 2019. During this period, we included and screened 60 slaughterhouse workers. The study was conducted among volunteer who were selected upon their consent. Any slaughterhouse worker who gave his consent to participate to the study was included. After an explanation about the aim of the study, each worker gave his consent by signing a consent form. Socio-demographic data and risk factors were collected by using an individually questionnaire.

Stools sample were collected from each participant in a clean jar. Each participant gave consent to the study after explanation and signed the consent form for participation in the study.

Ethical approval for this study was obtained from the Scientific and Ethical committee of the Health Research Ethics Committee (Approval Number: 048/2019/CBRS). Permission was sought from the management of each study site prior start the study. Confidentiality of information obtained was assured.

### 2.3 Sampling Method

A refrigerated slaughterhouse and two slaughter areas were selected: refrigerated slaughterhouse of the harbor area (ONAF), the slaughter areas of Agoè-Zongo and Gbossimè.

A letter of request was sent to the Livestock Direction of Lomé, Togo, which sent correspondence to ONAF to allow the study.

At the study site, an explanation was given to employees who were urged to participate in the study. Only those who had given their informed consent by signing the consent form were included in the study. A clean jar was given to each participant for this purpose, who will bring fresh stool the next day. The stool was transported in a cooler to the bacteriology laboratory at Sylvanus Olympio Teaching Hospital within 2 hours of collection. The samples are analyzed for the presence of Enterobacteriaceae producing Extended Spectrum Beta-Lactamase (ESBL).

### 2.4 Questionnaire Survey

The identification of risk factors for ESBLs included the administration of a questionnaire to slaughterhouse professionals. The questionnaire included socio-demographic data such as age, gender, marital status, neighbourhood of residence, education level and risk factors for carrying ESBLs, occupation, water used on site, working hours in the area, task performed on the site, self-medication, hospitalization in the previous year, antimicrobials used in the previous three months.

### 2.5 Microbiological Analysis

#### 2.5.1 Sample pre-treatment

Briefly about one gram of human fresh stool sample was inoculated in enrichment broth (thioglycolate broth) and incubated for 5 hours at 37°C. A loop-full culture from enrichment broth was streaked onto BCP selective agar + 6 µg/l Cefotaxime previously dried and incubated at 37°C for 18-24 hours.

### 2.5.2 Isolation and identification of ESBL-producing strains

Enterobacteriaceae grown on the selective medium BCP + 6 µg/l of Cefotaxime were selected according to their morphological appearance and re-isolated on the Uriselect® medium for identification. Non-ESBL strains didn't grow on this selective medium.

*Escherichia coli* strains were pink in colour on the Uriselect® medium. Other strains were identified by biochemical commercialized gallery API 20E (Biomérieux, France).

### 2.5.3 Antimicrobial susceptibility profiling

The antimicrobial susceptibility patterns of Enterobacteriaceae isolated strains were tested using the disk diffusion method (Kirby Bauer method) on Mueller Hinton Agar following standard zone size interpretative criteria recommended by CASFM-EUCAST (European Committee of Antibiogram susceptibility Testing) 2019 [21].

One colony from overnight culture on Mueller Hinton (MH) medium was picked using sterile Pasteur loop and emulsified in 5 ml of sterile normal saline to adjust the inoculum density equal to that of 0.5 Mc Farland turbidity standards ( $1.5 \times 10^8$  CFU/ml). Using a sterile swab, the bacteria was spread on Mueller Hinton agar to obtain a lawn culture within 24 hours. After air drying, commercially available antimicrobials discs (Oxoid, UK) were placed on the medium 30 mm apart and 15 mm away from the edge of the plate and incubated at 37°C for 24 hours. The agar was then dried. Inhibition zone diameter was measured with a double decimeter, recorded and values interpreted according to the recommendations of CASFM-EUCAST 2019.

The isolates were tested using a panel of 21 antimicrobials from different families commonly used to treat human bacterial infections namely Ampicillin 10 µg, Ticarcillin 75 µg, Amoxicillin + Clavulanic Acid 30 µg, Ticarcillin + Clavulanic Acid 85 µg, Cefoxitin 30 µg, Piperacillin 30 µg, Piperacillin + Tazobactam 36 µg, Ceftazidime 10 µg, Ceftriaxone 30 µg, Aztreonam 30 µg, Cefepime 30 µg, Imipenem 10 µg, Ertapenem 10 µg, Amikacin 15 µg, Gentamicin 10 µg, Chloramphenicol 30 µg, Sulfamethoxazole-Trimetoprim 25 µg, Nalidixic Acid 30 µg, Ciprofloxacin 5 µg, Levofloxacin 5 µg, Fosfomicin 200 µg. A standard reference

strain of *Escherichia coli* ATCC25922, sensitive to all antimicrobial drugs tested, was used as control.

### 2.5.4 Detection of the ESBL phenotype by the double disk method

All isolated strains of Enterobacteriaceae were tested for ESBL production by the double disk method during the antimicrobial susceptibility testing [22]. Combination disk Amoxicillin + clavulanic acid 20+10 µg or Ticarcillin + clavulanic acid 75+10 µg was applied at the center of Mueller Hinton Agar which was inoculated with the test strain. Ceftazidime 10 µg and Cefepim 30 µg disks frame Ticarcillin + Clavulanic Acid 75 + 10 µg disc 30 mm apart from each other and 15 mm from the edge of the plate. After 18-24 hours of incubation at 37°C, isolate that showed increase of  $\geq 5$ mm the zone of inhibition of the combination disks in comparison to that of the Ceftazidime and Cefepim disk was considered an ESBL. *Escherichia coli* ATCC 25922 and a *Klebsiella pneumoniae* ATCC 700603 were used as negative and positive controls, respectively.

## 2.6 Statistical Analysis

The collected data on a survey form were entered into the Excel software. The statistical analysis was done by the GraphPad Prism 8 and Excel software. The data were analyzed by calculating proportions, prevalence and P value. Statistical significance tests of risk factor for carrying enterobacteriaceae producing ESBL were performed using the Chi-square /Fisher's exact test at 5% level of significance (Graph Pad Prism software, version 8).

## 3. RESULTS

### 3.1 Socio-demographic Characteristics

All the screened slaughterhouse workers were male (100.0%). The age of the participants ranged from 23 to 76 years with a median age of 39 years. Almost (93.3%) (n= 56) of participants were married and 60.0% (n= 36) of them had a secondary school education (Table 1).

### 3.2 Prevalence of Carrying ESBL

The prevalence of ESBL-producing Enterobacteriaceae carriage was 80% (n = 48) among 60 screened professionals.

Upon 48 workers screened positive, 55 strains of ESBL-producing Enterobacteriaceae were isolated. *Escherichia coli* was the majority strain (78.2%) (n = 43) followed by *Klebsiella pneumoniae* (16.4%) (n = 9) and *Enterobacter cloacae* (5.4%) (n = 3) (Fig.1). In 7(11.7%) professionals, an association of two ESBL bacteria was found (Table 2).

Of the seven cases of association of bacteria, 5 (71.4%) were from Agoè Zongo slaughter area.

### 3.3 Carrying Risk Factors Analysis

Factors associated with ESBL carrying among slaughterhouse workers were:

Age (P <0,0001), marital statut (P <0,0001), duration of work (P = 0,0015), source of water used on the site (P <0,0001) work exposure (P <0,0001), hospitalization in the past year (P = 0,0001), self-medication with antibiotics (P < 0,0307).

Upon Fisher exact test at P ≤ 0,05 , the following factors were significant : age between 23-29 years old, single, 0-9 years of work, use of drilling water, antibiotics self-medication, hospitalization in the previous year. (Table 4)

### 3.4 Resistance Profile of Isolated Strains

The antimicrobial profile of *Escherichia coli*, *Klebsiella pneumoniae*, *Enterobacter cloacae* producing ESBL isolated showed in the group of Beta-Lactams, 100% resistance to Ampicillin,

Ticarcillin, Piperacillin, Ceftazidim, Ceftriaxon, Aztreonam and Cefepim.

*Escherichia coli* showed high resistance over 50% to Ticarcillin + Clavulanic Acid (79.07%), Ciprofloxacin (58.4%), and Sulfamethoxazole-Trimetoprim (86.05%).

The resistance rate of these antimicrobials was less than 50.00%: Amoxycillin + Clavulanic Acid (13.95%), Piperacillin + Tazobactam (9,30%), Piperacillin + Tazobactam (9,30%), Cefoxitin (2,33%), Levofloxacin (39,53), Nalidixic Acid (44.19%), Chloramphenicol (30.23%), Gentamicin (9.30%).

*Klebsiella pneumoniae* showed resistance to Amoxycillin + Clavulanic Acid (55,56%), Ticarcillin + Clavulanic Acid (100%), Piperacillin + Tazobactam (55.56%), Cefoxitin (7%), Ciprofloxacin (66,67%), Levofloxacin (33,33), Nalidixic Acid (22.22%), Chloramphenicol (22.22%), Gentamicin (44.44%), Sulfamethoxazole-Trimethoprim (88.89%).

Bacteria were 100% sensitive to Imipenem, Ertapenem and Amikacin. (Table 5).

## 4. DISCUSSION

The present study aimed to examined the prevalence and risk factors for carrying ESBL-producing enterobacteriaceae among apparently healthy slaughterhouses professional in Lomé and their resistance profile to antibiotics.

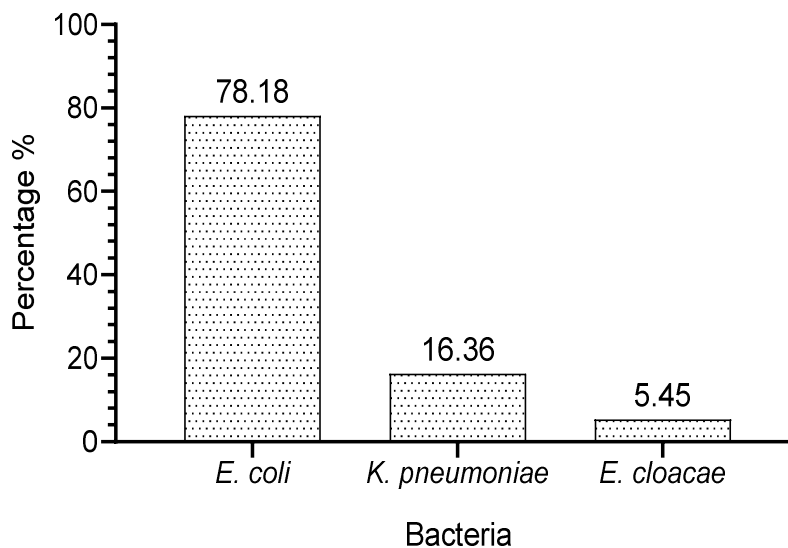


Fig. 1. Proportion of isolated enterobacteria from slaughterhouse workers in Lomé, 2019

**Table 1. Socio-demographic characteristics of slaughterhouse workers in Lomé-Togo, 2019**

Characteristics	N	%
<b>Marital status</b>		
Married	56	(93.3)
Single	4	(6.7)
<b>Education level</b>		
Uneducated	4	(6.7)
Primary	14	(23.3)
Secondary	36	(60.0)
Superior	6	(10.0)
<b>Profession</b>		
Butcher/ porkbutcher	31	(51.7)
Skilled and specialized worker	16	(26.7)
Veterinarian	4	(6.7)
Inspection Officers	5	(8.3)
Tax collector	3	(5.0)
Security guard	1	(1.7)
<b>Duration of work (years)</b>		
0-9	22	(36.7)
≥ 10	38	(63.3)
<b>Locality</b>		
Slaughterhouse ONAF	29	(48.3)
Slaughter area of AgoèZongo	20	(33.3)
Slaughter area of Gbossime	11	(18.3)

**Table 2. Distribution of ESBL producing bacteria association by slaughterhouse area**

Area	<i>Escherichia coli</i> and <i>Klebsiella pneumoniae</i> N/(%)	<i>Escherichia coli</i> and <i>Enterobacter cloacae</i> N/(%)	<i>Escherichia coli</i> and <i>Escherichia coli</i> * N/(%)	Total N/ (%)
Slaughterhouse ONAF	1 (25)	1 (100)	0 (0)	2 (28.57)
Slaughter area of AgoèZongo	3 (75)	0 (0)	2 (100)	5 (71.43)
Slaughter area of Gbossime	0 (0)	0 (0)	0 (0)	0 (0)
Total	4 (100)	1 (100)	2 (100)	7 (100)

\*phenotype was different

**Table 3. Distribution of slaughterhouse workers and ESBL carriage over different contact exposure in Lomé, 2019**

	Total	ESBL Carriers N/%	Non ESBL Carriers N/%
<b>High exposure</b>			
Contact with carcass	17 (28.33)	15 (31.25)	2 (16.67)
Contact with stomach content	5 (8.33)	5 (10.42)	0 (0)
Contact with live animals	6 (10)	6 (12.50)	0 (0)
Contact with live animals, carcass, stomach content, animal faeces, blood	27 (45)	18 (37.50)	9 (75)
Contact with carcass, stomach content	1 (1.67)	0 (0)	1 (8.33)
<b>Lower exposure</b>			
Tax collector	3 (5)	3 (6.25)	0 (0)
Security guard	1 (1.67)	1 (2.08)	0 (0)

**Table 4. Overview of participant characteristics and P value from the Fisher exact test for the probability of ESBL carriage in Lomé, 2019**

ESBL Carrying risk factors	ESBL carriers N (%)	Non ESBL carriers N (%)	P value
<b>Age</b>			
23-29	8 (100%)	0 (0%)	<0,0001
≥ 30	40 (77%)	12 (23%)	
<b>Matrimonial statut</b>			
Married	44 (79%)	12 (21%)	<0.0001
Single	4 (100%)	0 (0%)	
<b>Education Level</b>			
Less than Secondary	15 (83%)	3 (17%)	0.5891
Secondary and above	33 (79%)	9 (21%)	
<b>Duration of work</b>			
0-9 years	21 (91%)	2 (9%)	0.0015
≥ 10 years	27 (73%)	10 (27%)	
<b>Source of water used on the work site</b>			
Borehole	30 (97%)	1 (3%)	<0.0001
National water supply (TDE*)	18 (62%)	11 (38%)	
<b>Work Exposure</b>			
High exposure	44 (79%)	12 (21%)	<0.0001
Lower exposure	04 (100%)	0 (0%)	
<b>Antibiotics Self-medication</b>			
Yes	31 (91%)	3 (9%)	<0.0001
No	17 65%	9 (35%)	
<b>Hospitalization previous year</b>			
Yes	2 (100%)	0 (0%)	<0.0001
No	46 (79%)	12 (21%)	
<b>Antimicrobials in the previous 3 months</b>			
Yes	11 (73%)	04 (27%)	0.1751
No	37 (82%)	08 (18%)	

\*Togolaise des eaux

Studies shown that there is an increase of prevalence of ESBL fecal carriage over the world. Studies from three different areas in Spain (Madrid, Barcelona and Zaragoza) showed the prevalence of fecal carriage between 5.5% and 8.1% during 2002 and 2004 [23-25]. The prevalence of fecal carriage was 1.4% in York (UK) in 2003, 2.4% in Lebanon [26] and 7% in India [27]. A higher rate was found in Saudi Arabia (15.4%) [28].

This study showed a very high carrying rate (80%) of these ESBL-producing enterobacteriaceae. This is similar to the findings from Luvsansharav U *et al.* in Japon (69.3%) in 2012 on Prevalence of and risk factors associated with fecal carriage of CTX-M  $\beta$ -lactamase-producing Enterobacteriaceae in rural Thai communities [29]. A high prevalence above 50% has also been observed among healthy individuals (57%) for *Escherichia coli* in a study

conducted by Saleem *et al.* in 2017 in Pakistan [30]. On the other hand, studies conducted by Michaud *et al.* in Senegal in 2014 among farm workers showed a low digestive carrying rate (9.4%) [18]. This high frequency of ESBL-producing enterobacteriaceae in our study could be explained by permanent contact with the animals and their unhealthy working environment. It may be correlated to the poor hygienic measures observed in our study. This situation reveal a veritable problem of public health.

*Escherichia coli* is the most isolated ESBL producing enterobacteriaceae with 78.18% followed by *Klebsiella pneumoniae* 16.36%. This is similar to the findings from a study conducted in Thailand on fecal specimens from the healthy individuals reported that majority of the isolates were ESBL-producing *Escherichia coli* (85.1%) [31]. This is confirmed by the work of Toudji *et al.*

in 2017 [19] which also reported *Escherichia coli* 51.13% as the majority strain of isolated ESBL followed by *Klebsiella pneumoniae* 30.10%. This result is far from the findings from poultry workers in the Federal Capital Territory, Abuja, Nigeria which reported low prevalence of ESBL producing *E. coli* (16,7%) [32]. It is the same for findings from a survey of households and chicken farms in the Mekong Delta in Vietnam with Nguyen V. T *et al.* who reported a very low prevalence of ESBL producing *E. coli* (3.2%) [33].

Our study showed an association of two bacteria producing ESBL in two slaughterhouses areas particularly the slaughter area of AgoèZongo which gathered 71,43% (5/7) of the associations. Factors associated with ESBL carrying among slaughterhouse workers in our study were the age under 30 years, singles, the duration of work under 10 years, the use of only borehole water

on the site, the lower work exposure, hospitalization in the past year and self-medication with antimicrobials.

High consumption of antibiotics in self-medication may be a risk factor for the high prevalence of ESBL-producing Enterobacteriaceae. In this regard, previous studies have reported correlations between antimicrobial resistance and antimicrobial usage [34,35].

Our risk factor analyses show that even in the community setting, duration of work and self-medication with antimicrobials have a major contribution to the fecal carriage of resistant bacteria. A history of hospitalization in the past year, the age, the marital status, the source of water use on the site and work exposure indicated higher risks of carrying ESBL-producing Enterobacteriaceae.

**Table 5. Resistance profile of isolated strains from slaughterhouse workers in Lomé, 2019**

Antimicrobials group	Name of antimicrobial disk	Rate of résistance (%)		
		<i>Escherichia coli</i> N=43 strains	<i>Klebsiella pneumoniae</i> N = 9 strains	<i>Enterobacter cloacae</i> N = 3 strains
Beta – Lactams	Ampicillin (10µg)	100	100	100
	Amoxicillin- Clavulanic Acid (20-10µg)	13.9	55.6	66.7
	Ticarcillin (75µg)	100	100	100
	Ticarcillin + Clavulanic Acid (75-10µg)	79.1	100	66.7
	Piperacillin (30µg)	100	100	100
	Piperacillin + Tazobactam (36µg)	9.3	55.6	0
	Cefoxitin (30µg)	2.3	0	66.7
	Ceftazidim (10µg)	97.7	100	100
	Ceftriaxon (30µg)	100	100	100
	Cefepim (30µg)	100	100	100
	Aztreonam (30µg)	100	100	100
	Imipenem (10µg)	0	0	0
	Ertapenem (10µg)	0	0	0
	Aminosids	Amikacin (30µg)	0	0
Gentamicin (10µg)		9.3	44.4	66.7
Sulfonamides and associates	Sulfamethoxazole-Trimethoprim (27,75-1,25µg)	86.0	88.9	100
Phenicol	Chloramphenicol (30µg)	30.2	22.2	66.7
Quinolons and	Nalidixic Acid (30µg)	44.2	22.2	33.3
Fluoroquinolons	Ciprofloxacin (5µg)	58.1	66.7	66.7
	Levofloxacin (5µg)	39.5	33.3	0
Other family	Fosfomycin (200µg)	0	33.3	0



Our study showed that the lower work exposition with animals and carcass like tax collection and safety guardian is associated with ESBL carriage. This is different from findings from Dohmenet *al.* which study revealed that slaughterhouse workers were more likely to carry ESBL when working in the early slaughtering steps (before chilling of the pig carcasses) than slaughterhouse workers working from this slaughter step forward, i.e. working in the cooling, cutting and deboning area [36].

Besides the describe risk factors, none of the analyzed determinants such as education level, antibiotics use in the previous three months were found to be risk factors for ESBL carriage in slaughterhouse workers.

Some studies showed that prior hospitalization or previous use of antimicrobial drugs was irrelevant for the fecal carriage of ESBL-producing Enterobacteriaceae in healthy people. Our results regarding hospitalization aspect for fecal carriage differ from previous findings.

Hospitalization and the use of antimicrobials, which have been described as possible risk factors in previous studies [37,38] is confirmed in our study and show an association with ESBL-carriage.

Our study also observed that ESBL producing *Escherichiacoli* isolates from slaughterhouse workers showed high resistance rates for sulfamethoxazole-trimethoprim, chloramphenicol, nalidixic acid and fluoroquinolones, however, we observed low resistance rates for gentamicin 9,30% and susceptibility à 100% for Amikacin and Fosfomycin. *Klebsiella pneumoniae* strains isolated shown high resistance for gentamicin sulfamethoxazole-trimethoprim, chloramphenicol, fosfomycin, nalidixic acid and fluoroquinolones. Studies of Saleem R. *et al.* in Pakistan have shown that extended-spectrum  $\beta$ -lactamases (ESBL)—producing *Escherichiacoli* are resistant to several antimicrobials especially penicillins and cephalosporins however, they are susceptible to cephamycins and carbapenems [29]. This can be confirmed by our study where all strains studied were 100% sensitive to imipenem, ertapenem. *Escherichiacoli* strains were 97.67% sensitive to cefoxitin, and *Klebsiella pneumoniae* were 100% sensitive. A research done on Parisian checkup centre showed the sensitivity pattern in which none of the ESBL-producing *Escherichia coli* isolate was resistant to piperacillin-tazobactam, imipenem or amikacin

[39]. As these bacteria are multi-resistant to several families of antimicrobials, an infection with these germs would be difficult to treat and would force the use of the latest generation of antibiotics such as carbapenems and also cephamycin.

## 5. CONCLUSION

This study carried out in three main slaughterhouses in Lomé, the capital city of Togo demonstrated a high rate of carrying of multi-resistant enterobacteriaceae, mainly ESBL producing *Escherichia coli*, among the staff of these workplaces. This confirms the existence of a sanitary risk for the community in terms of biosecurity. This situation could increase the risk of develop a severe infection amongst the carriers in case of sickness which lower the immune system. Furthermore, it could lead to a spread of multi resistant bacteria in the hospital started from carrier. It is urgent to take steps to promote good animal husbandry practices for animal welfare and good hygiene practices in Togo's slaughterhouses.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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