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Diversity and Distribution of *Salmonella* Isolated from Poultry Offal in Niger (West Africa)

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Abstract: Objective: The aim of this study is to determine the prevalence and phenotype diversity of *Salmonella* isolated from poultry offal in Niger. Methodology and Results: A total of 155 poultries offal consisting of gizzard, liver and spleen were analyzed according to ISO 6579: 2002. Based on these different analyzes, high prevalence of *Salmonella* from 20% to 69% was found. Serotyping showed the predominance of Derby 42.37% followed by *S*. Hato 15.25%, *S*. Chester 10.17%, *S*. Agona 5.08%, *S*. Suberu and *S*. Essen 3.39% each, *S*. Hessarek and *S*. Kissangani 1.69% each. Isolated *Salmonella* strains showed low resistance to antibiotics. Conclusion and perspective: Poultry offal for human consumption has high concentration of *Salmonella*. This is due to poor hygienic practices of poultry sellers. From these facts, awareness and training measures are necessary. Niger authorities must also build modern slaughterhouses and poultry markets in order to reduce the risk infectious proliferation of diseases such as gastroenteritis and food poisoning.

Keywords: *Salmonella*, Diversity, Serotypes, Poultry Offal, Niger

1. Introduction

Salmonella are one of the first causes of food contamination in developing countries as well as in industrialized ones. Food risk is little tolerated by the population and some zoonotic food pathogens are in the center of most concerns. Among pathogens, *Salmonella* was the second cause of bacterial food toxi-infections in Europe [1]. An over world epidemic bound to *Enteritidis* serovar of which the evident source still egg layer chicken began around the eighties. Since then, multi-resistant clones have emerged and their impact upon human health in terms of morbidity and mortality has been documented [2]. They, by the way, stand for public health issue and the community owes for that. Chicken business is considered as one of major sources of human contamination [3-4], whether fresh or undercooked foods as chicken meat, eggs and ovoproduct, charcuteries etc. [5-9]. In sub-Saharan Africa, *Salmonella* are one of the important causes of acute gastroenteritis and invasing infections. They cause 20 to 25% of mortality. Almost 70 million tons of poultry are produced per year, of which almost 85% are chicken. That's the second type of eaten meat over the world right after pig [10]. Food from animals, particularly chicken, are widely recognized as *Salmonella* sources due to wide spreading of *Salmonella* over gastrointestinal tract of chicken [11-14]. In Niger, Poultry farming is increasing. Avicole livestock is around 12 196 000 units in 2009 [15]. Also, family aviculture constitutes the main source of animal protein in rural areas in Niger [16]. The offal of poultry, particularly the gizzard and the liver are the top appreciated and much eaten in Niger but they are likely to contain pathogen germs such as the *Salmonella* [17-18]. Such top eaten products still remain unknown as far as their microbiological quality. In Niger, very little data are available on this topic. This study has been conducted to determine the prevalence of *Salmonella* in offal of poultry and to assess the distribution of the isolated serotype of these products

in Niger.

2. Materials and Methods

2.1. Presentation of Poultry Offal Collection Sites

Collection of samples has been conducted in seven areas of Niger except Diffa area. In every area a chicken slaughtering site has been chosen (Table 1).

Table 1. *Characteristics of study sites of poultry offal.*

Regions	Sites	Collection dates	Number of samples
Niamey	Wadata February 2016	27/02/2016	18
	Wadata August 2016	14/08/2016	22
Tillabéri	Stade	17/03/2016	20
Dosso	Gaya Koirategui	26/03/2016	18
Maradi	Ali Dan Sofo	01/05/2016	18
Zinder	Pantchis	02/05/2016	20
Tahoua	Maboya Amaré	07/06/2016	17
Agadez	Sabon Gari	08/06/2016	22
Total			155

Figure 1. *Poultry Slaughter sites in Niger.*

A and B: Poultry slaughter sites of Sabon Gari Agadez, Niger; C and D: Poultry slaughter sites of Ali Dan Sofo Maradi, Niger. (Figures Alio *et al.,* 2016).

2.2. Poultry Offal Sampling

The study has combined inquiries questionnaires and, sampling and analysis in laboratory. In every slaughter site, only samples of available poultry offal were collected (Figure 1). Samples were put in icebox at 4°C and are taken to the laboratory. Every sampling is accompanied by questionnaire. In sum 155 samples of poultry offal were collected.

2.3. Microbiological Analyzes

The microbiological analysis was done according to ISO 6579:2002 in 4 steps: pre-enrichment, enrichment, isolation and biochemical identification. The microbiological analysis for the research of *Salmonella* was realized on 155 poultry offal in order to determine the prevalence and different serotypes flowing in the poultry. Samples were sent to the laboratory in an isothermal thermos at 4°C and treated in the day time. Then, they were placed on gelose Mueller Hinton and incubated at 37°C for 18-24 hours. Suspicions settlements were submitted to biochemical reactions by using gallery API 20E Enteric according to producers. Biochemical profiles have been converted into a numerical profile in other words a number that permits an easy transcription of all obtained for an organism and compared to list in the index. The 21 corresponding reactions were coded and separated by groups of three (3). A value 1, 2 or 4 is indicated for each of the reaction, giving a numerical code of 7 numbers. After biochemical tests, some strains were read and confirmed. The results were compared following a Ascending Hierarchical Classification (AHC). Binary chart were realized on the basis of the positivity or the negativity of biochemical tests. The similarity between strains is determined following the Euclidean index and a dendrogram illustrated this produced similarity. Moreover, the serotyping was made according to the schema of KAUFFMANN-WHITE (1934): The isolated pure culture on gelose was stereotyped by the direct agglutination technique on blade by following on a panel antisera (O, H and Vi) (Bio-Rad®). The determination of serotypes is the combination of antigenic formulas corresponding to the antigens "O" and "H» expressed during different agglutinations. All the isolates were tested for susceptibility to 18 different antimicrobial agents using the Mueller Hinton II Agar Diffusion Method (Bio-Rad France) according to EUCAST guidelines (European Committee on Antimicrobial Susceptibility Instructions). The antimicrobial disks used were ampicillin: AMP (10 µg); amoxicillin: AML (25µg); amoxicillin + clavulanic acid: AMC (20/10 µg); ceftazidime: CAZ (30µg); cefotaxime: CTX: (30µg); ceftriaxone: CRO (30µg); Cefepime: FEP: (30µg); chloramphenicol: C (30µg); gentamicin: GM: (10µg); aztreonam: AZT (30µg); amikacin: AK (30µg); Trimethoprim-sulfamethoxazole: SXT (1.25/23.75µg); nalidixic acid: NA (30µg); colistin: COL (10µg); ciprofloxacin: CIP (5µg); imipenem: IPM (10µg). Inhibition diameters of antibiotics were interpreted according to EUCAST. Finally, isolates resistant to ampicillin, amoxicillin, cefotaxime, ceftriaxone, gentamicin, nalidixic acid and ciprofloxacin were evaluated for Minimal Inhibitory Concentration (MIC) by the method of E - test according to the manufacturer's and European Committee on Antimicrobial Susceptibility Instructions (EUCAST) guidelines (EUCAST, 2013).

2.4. Statistics Analyses

The obtained data from the inquiry cards were treated with software XL-Stat version 2010 in other to determine the parameters impacting the presence of *Salmonella*. The results of bacteriological analysis were typed using the Microsoft Excel 2013 software for the preparations of graphics and charts. The PCORD 5 software was used to study biochemical similarity with the means of Ascending Hierarchical Classification (AHC).

3. Results

3.1. Characteristics and Practices Poultry Sellers

The chart 2 presents the characteristics and practices of poultry sellers with regard to the most suitable parameters that can influence product quality. The sellers are exclusively male (100%), 62.5% are lets old than 30 years, and are predominantly Hausa (50%) and illiterate (75%). Most of them (75%) have never been sensitized about hygiene when manipulating poultry. Hand washing is practiced by 75% but after the activity of product dealing (50%). No interrogated sellers have a medical examination last year.

Table 2. *Characteristics and practices poultry sellers.*

Definition of the variable	Level	Number	Percentage (%)
Age (Years)	< 30	5	62.5
	30-60	3	37.5
	>60	0	0
Sex	Man	8	100
	woman	0	0
Ethnic group	Hausa	4	50
	Zarma	2	25
	Dendi	1	12.5
	Kanuri	1	12.5
Level of study	Non scholarized	6	75
	Primary	1	12.5
	secondary	1	12.5
Sensitization about Hygiene	Yes	2	25
	No	6	75
Hands washing	Yes	6	75
	No	2	25
Period of hands washing	Before	3	33.33
	During	1	16.67
	After	2	50
Medical examination	Yes	0	0
	No	8	100

3.2. Prevalence of Isolated Salmonella of Poultry in Niger

A total of 155 samples of poultry offal were analyzed. *Salmonella* spp were isolated in 59 (38.06%) samples. the Figure 2 shows the distribution of isolation frequencies of *Salmonella* according to the regions of Niger. The reported frequencies vary between 69% in Niamey and 20% in Zinder and Tillabéri.

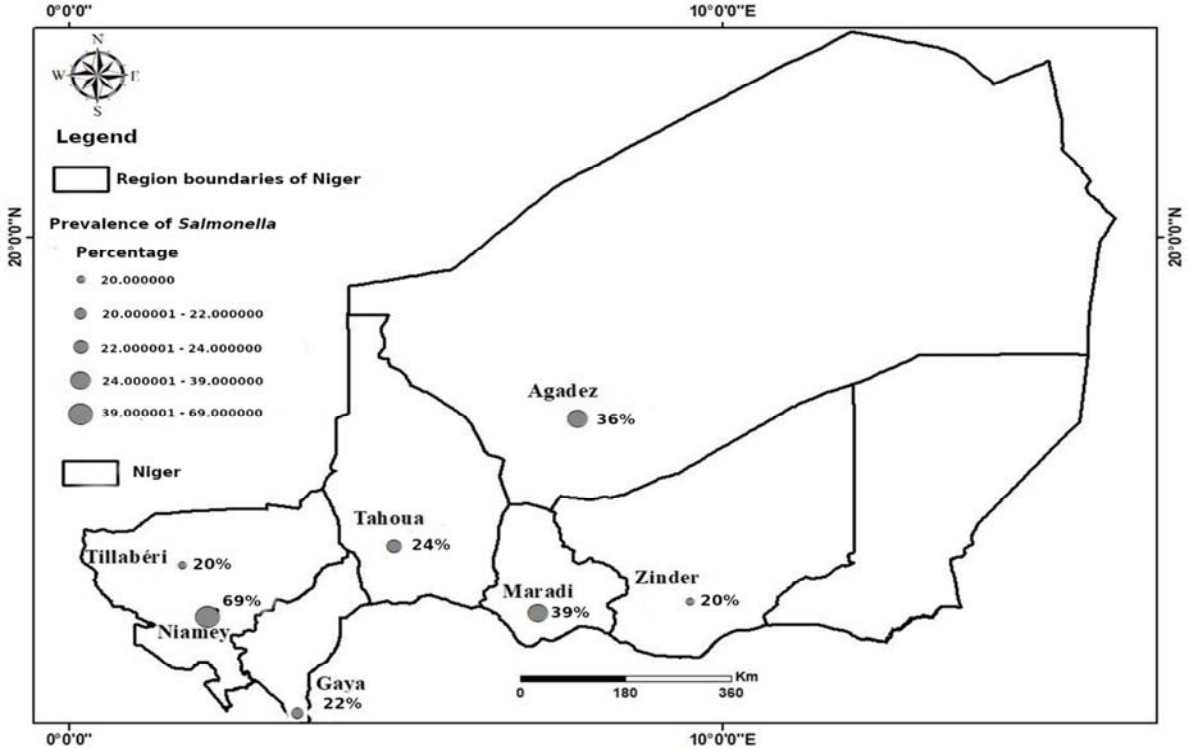

Figure 2. *Distribution and frequencies of Salmonella isolated from poultry offal in the different regions of Niger.*

3.3. Biochemical Characteristics of Isolated Strains from Poultry

The grouping of *Salmonella* strains by Ascending Hierarchical Classification (AHC) on the basis of biochemical tests divides the 35 identified strains into two groups:

Group 1 is constituted of 94.29% (33/35), the majority of isolates. It is presented by the reading code for the gender determination: 6704752 which corresponds to an excellent identification of *Salmonella* spp. Strains in this group are characterized by their ability to degrade inositol (INO^+) which is an unusual biochemical characteristic in *Salmonella*.

Group 2 is constituted of 5.71% (2/35) of the isolates and have the reading code 6704552 for the genus determination which also corresponds to an excellent identification of *Salmonella* spp and differs from the group1 by INO^- (Figure 3).

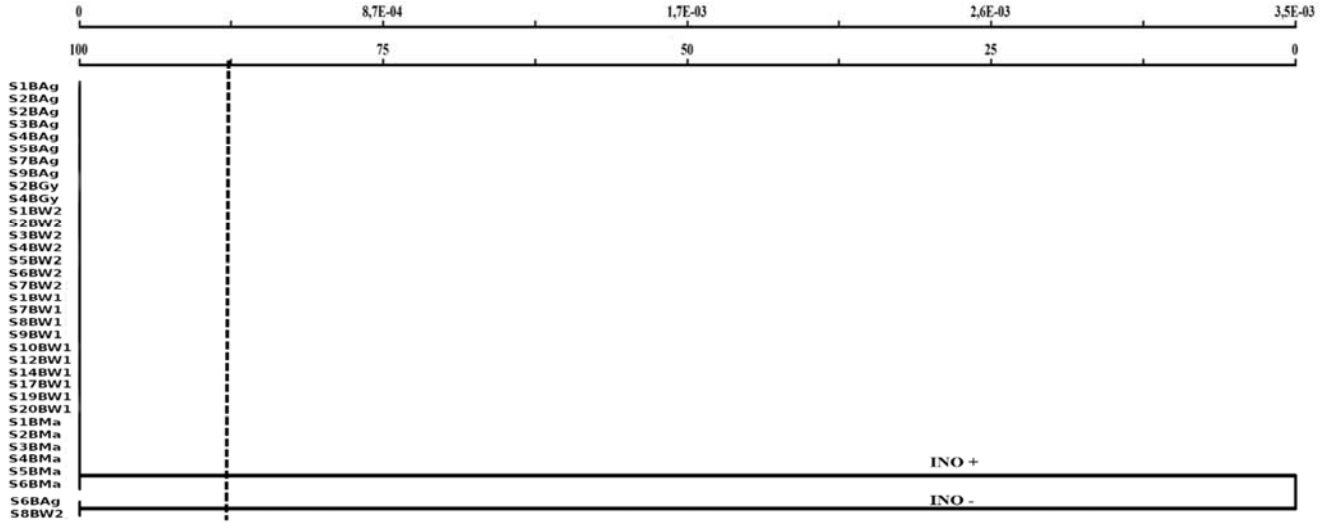

Figure 3. *Ascending Hierarchical Classification (AHC) Dendrogram representative of the similarity of the biochemical characteristics of Salmonella isolated from poultry offal.*

3.4. Prevalence of Salmonella Serotypes Isolated from Poultry

Serotyping *Salmonella* isolates from poultry offal allowed to observe eight (8) circulating serotypes in Niger (Figure 4). The predominant serotype is *Salmonella* Derby (42.37%) and the least frequent are *S.* Hessarek (1.69%) and *S.* Kissangani (1.69%). However, 16.95% of the isolates could not be serotyped.

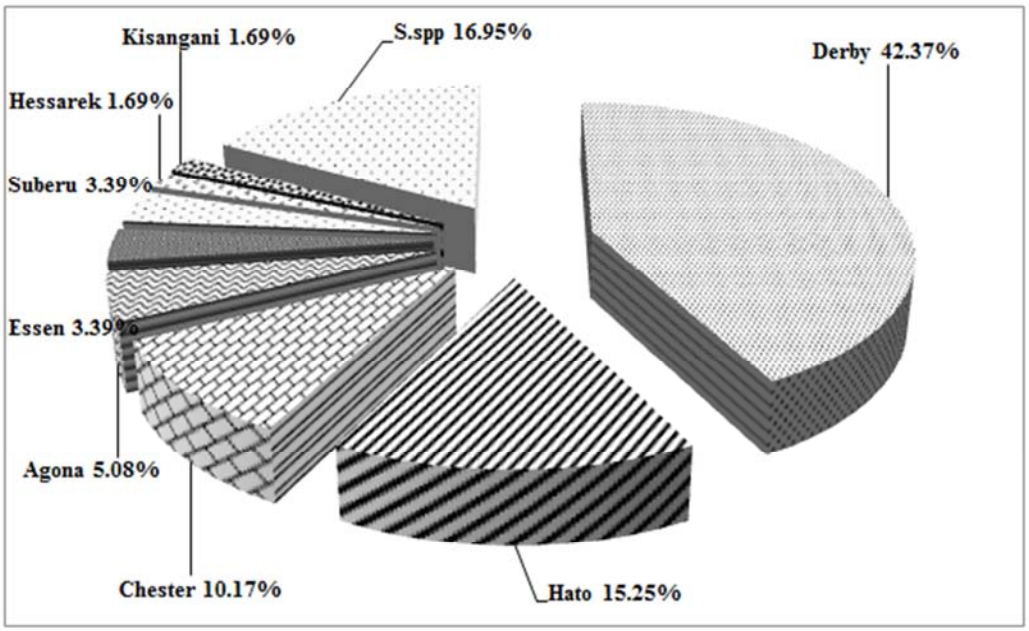

Figure 4. *Percentage of different serotypes of Salmonella isolated from poultry offals.*

3.5. Distribution of Antibiotic Sensitivity

Isolated strains of *Salmonella* from poultry offal showed resistance to the family of penicillin A [ampicillin (11.43%), amoxicillin (9.30%), amoxicillin + clavulanic acid (6.98%)]; polymyxin (colistin (45%) and trimethoprim-sulfamethoxazol (9.30%). There is also noticed a strong diminution of sensitivity to antibiotic with strains presenting intermediate susceptibility to ampicillin (48.57%), ofloxacin (11.63%), amoxicillin + clavulanic acid (9.3%), cefotaxim, ceftriaxone, amikacin respectively (6.98%), trimethoprim-sulfamethoxazol (4.65%) and azetronam (2.33%). All the *Salmonella* isolates were sensitive to ceftazidime, naladixic acid, ciprofloxacin and imipenem (Figure 5).

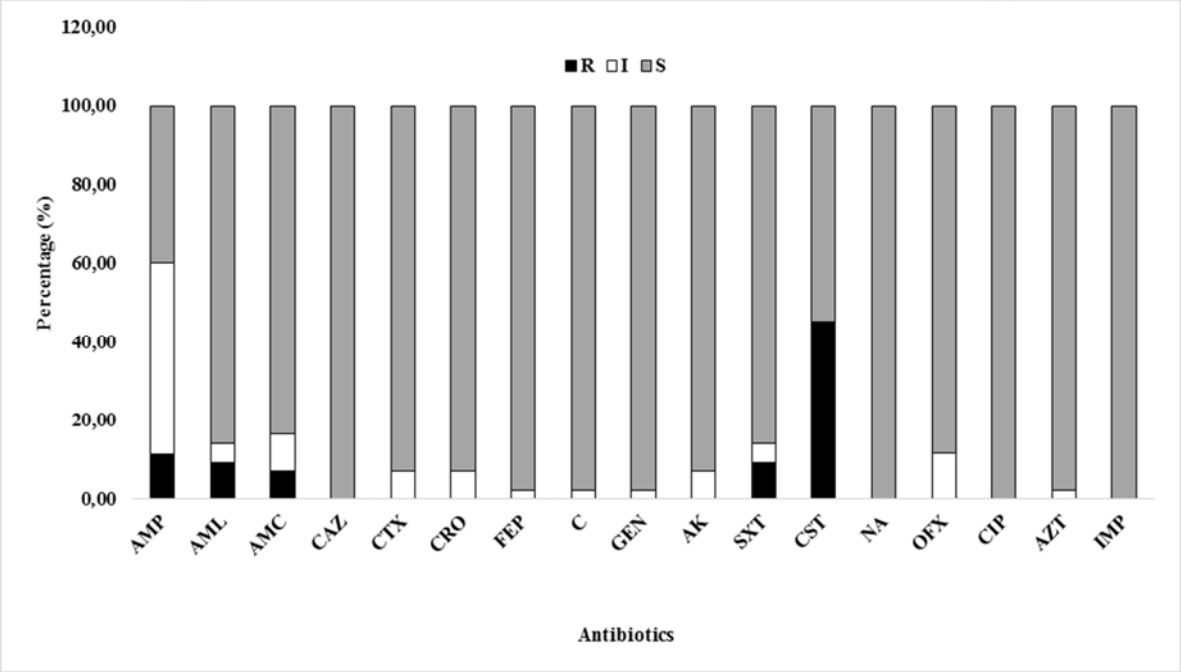

Figure 5. *Frequency of antibiotic resistance of Salmonella strains isolated from poultry offal.*

The black color corresponds to the resistance zone (R). The white color corresponds to the intermediate zone (I). The gray color corresponds to the sensitive zone (S). AMP: Ampicillin; AML: amoxicillin, AMC: amoxicillin + clavulanic acid; CAZ: ceftazidime; CTX: cefotaxime; CRO: Ceftriaxone; FEP: cefepime; CFM: cefixime; C: chloramphenicol; GEN: gentamicin; AZT: aztreonam; AK: amikacin SXT: trimethoprim-sulfamethoxazole; NA: nalidixic acid; COL: colistin; CIP: ciprofloxacin; IPM: imipenem.

3.6. Distribution of Salmonella Serotypes Isolated from Poultry Offal According to Regions and Collection Areas

Salmonella Derby is practically found in all regions of Niger with (62.5%) in Niamey, (8.33%) in Gaya, (12.5%) in Agadez, (12.5%) in Tahoua and (4.1%) in Maradi, with the exception of Zinder and Tillaberi. As *Salmonella* Hato in Niamey, Tillaberi, Gaya, Maradi and Agadez. Other serotypes have been found exclusively in one region: *Salmonella* Suberu in Niamey (Wadata August 2016), *S*. Hessarek and *S*. Kisangani in Zinder and *S*. Essen in Agadez (Table 3).

Table 3. *Distribution of serotypes of isolated strains of Salmonella from poultry offal based on collection areas.*

Serotypes	Niamey		Dosso Gaya (n=4)	Maradi (n=7)	Zinder (n=4)	Agadez (n=10)	Tahoua (n=4)	Tillabéri (n=4)	Total
	Wadata (n=19)	Wadata (n=7)							
Derby	14 (73,68)	1 (14,29)	2 (50)	1 (14,29)	-(-)	3 (30)	3 (75)	-(-)	24
Hato	4 (21,05)	-(-)	1 (25)	1 (14,29)	-(-)	1 (10)	-(-)	1 (25)	8
Chester	-(-)	4 (57,14)	-(-)	-(-)	2 (50)	-(-)	-(-)	-(-)	6
Suberu	-(-)	2 (28,57)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	2
Agona	-(-)	-(-)	1 (25)	-(-)	-(-)	-(-)	1 (25)	1 (25)	3
Hessarek	-(-)	-(-)	-(-)	-(-)	1 (25)	-(-)	-(-)	-(-)	1
Kisangani	-(-)	-(-)	-(-)	-(-)	1 (25)	-(-)	-(-)	-(-)	1
Essen	-(-)	-(-)	-(-)	-(-)	-(-)	2 (20)	-(-)	-(-)	2
Salmonella spp	1 (5,26)	-(-)	-(-)	5 (71,43)	-(-)	4 (40)	-(-)	2 (50)	12

-: zero (0).

3.7. Frequency of Antibiotic Resistance of Salmonella Serotypes Isolated from Poultry Offal

The resistance frequencies of *Salmonella* serotypes are summarized in Table 4. The Derby, Chester and *Salmonella* Spp serotypes (OMA, OMB, OMC, OMD-) were resistant to four (4) antibiotics. *Salmonella* Derby and *Salmonella* Spp (OMA, OMB, OMC, OMD -) presented the resistance profile according to AMP, AML, AMC, CST and *Salmonella* Chester: AML, AMC, SXT, CST.

Salmonella Hato and *S.* Hessarek were resistant to three (3) antibiotics. *Salmonella* Hato presented the resistance profile AMP, SXT, CST and *S.* Hessarek, resistance profile AMP, AML, CST. Two serotypes presented a resistance profile only to colistin, it is *S.* Essen and *S.* Suberu. Most serotypes were resistant to colistin. The percentage of resistance to colistin was between 28.57% for the *S.* Chester serotype and 100% for the *S.* Essen and *S.* Suberu serotypes.

Table 4. *Frequency of antibiotic resistance of Salmonella serotypes isolated from poultry offal.*

Serotypes	Antibiotics							
	AMP	AML	AMC	CAZ	CTX	CRO	CFM	FEP
Derby	3 (23,08)	2 (15,38)	1 (7,69)	-(-)	-(-)	-(-)	-(-)	-(-)
Chester	-(-)	1 (14,29)	1 (14,29)	-(-)	-(-)	-(-)	-(-)	-(-)
Hato	1 (16,67)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)
Hessarek	1 (33,33)	1 (33,33)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)
Essen	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)
Suberu	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)
Agona	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)
Kisangani	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)
OMA, OMB, OMC, OMD -(-)	3 (33,33)	1 (11,11)	1 (11,11)	-(-)	-(-)	-(-)	-(-)	-(-)
ND	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)

Table 4. *Continue.*

Serotypes	Antibiotics										
	C	GEN	AK	SXT	CST	NA	OFX	CIP	AZT	IMP	Total
Derby	-(-)	-(-)	-(-)	-(-)	7 (53,85)	-(-)	-(-)	-(-)	-(-)	-(-)	13
Chester	-(-)	-(-)	-(-)	3 (42,86)	2 (28,57)	-(-)	-(-)	-(-)	-(-)	-(-)	7
Hato	-(-)	-(-)	-(-)	1 (16,67)	4 (66,67)	-(-)	-(-)	-(-)	-(-)	-(-)	6
Hessarek	-(-)	-(-)	-(-)	-(-)	1 (33,33)	-(-)	-(-)	-(-)	-(-)	-(-)	3
Essen	-(-)	-(-)	-(-)	-(-)	1 (100)	-(-)	-(-)	-(-)	-(-)	-(-)	1
Suberu	-(-)	-(-)	-(-)	-(-)	1 (100)	-(-)	-(-)	-(-)	-(-)	-(-)	1
Agona	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	0
Kisangani	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	0
OMA, OMB, OMC, OMD -(-)	-(-)	-(-)	-(-)	-(-)	4 (44,44)	-(-)	-(-)-(-)	-(-)-(-)	-(-)	-(-)	9
ND	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	0

AMP: Ampicillin; AML: amoxicillin, AMC: amoxicillin + clavulanic acid; CAZ: ceftazidime; CTX: cefotaxime; CRO: Ceftriaxone; FEP: cefepime; CFM: cefixime; C: chloramphenicol; GEN: gentamicin; AZT: aztreonam; AK: amikacin; SXT: trimethoprim-sulfamethoxazole; NA: nalidixic acid; COL: colistin; CIP: ciprofloxacin; IPM: imipenem.; -: zero (0).

3.8. Study of Similarity of Antibiotic Resistance Patterns Between Isolated Strains of Salmonella from Poultry

Results of antibiotic profiles of isolated strains from poultry were submitted to AHC (Ascending Hierarchical Classification) analysis to visualize the similarity of the strains. It allowed to individualize six (6) groups (Figure 6):

Group 1: constituted of 40 strains. They are characterized by sensitivity to all antibiotics;

Group 2: constituted of 2 strains. They were characterized by ampicillin resistance compared to group 1;

Group 3: constituted of 2 strains. They differ from those of group 1 by resistance to colistin;

Group 4: constituted of 4 strains which differ from group 3 by the resistance to ampicillin, amoxicillin, amoxicillin + clavulanic acid and trimethoprim-sulfamethoxazole;

Group 5: constituted of 4 strains. They are characterized by the resistance to colistin;

Group 6: constituted of a single strain. They are characterized by the resistance to ampicillin, with amoxicillin, amoxicillin + clavulanic acid and colistin.

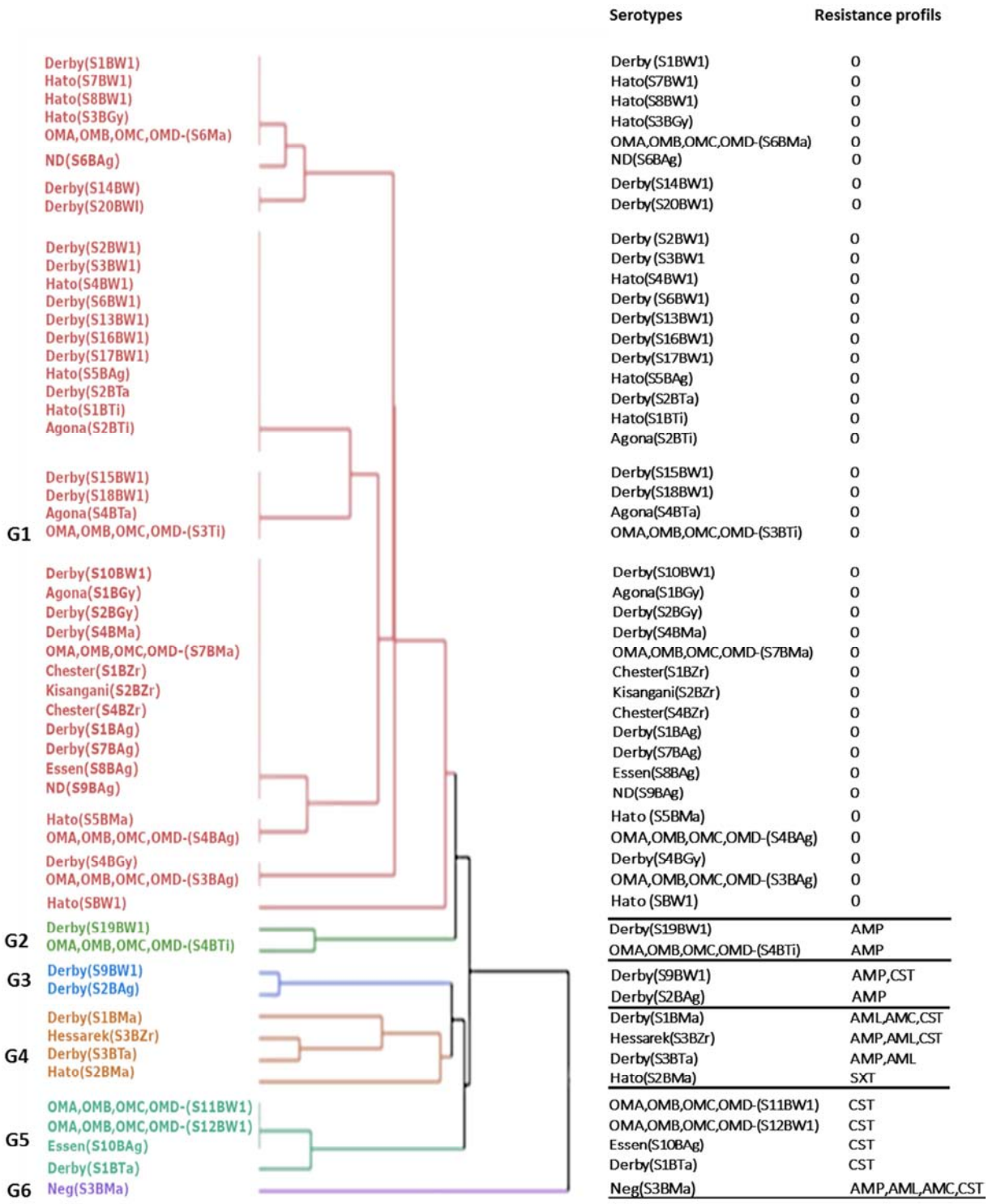

Figure 6. *Similarity of antibiotic sensitivities of Salmonella isolated from poultry.*

3.9. Distribution of Salmonella Number According a Function of Their Minimum Inhibitory Concentrations (MIC)

Determination of the Minimum Inhibitory Concentration (MIC) has shown that 100% (4/4) isolated *Salmonella* of poultry presented a non-wild phenotype with respect to ampicillin and amoxicillin. 75% (3/4) of the strains showed maximum resistance (MIC> 256mg/l) to amoxicillin. No strains has shown total resistance to ampicillin (MIC> 256mg /l) (Table 5).

Table 5. *Distribution of strains resistant to antibiotics isolated from poultry according to their minimum inhibitory concentration (MIC).*

Antibiotics	% of strains		Resistance > CMI (mg/l)																
	Non-wild	Resistances	1	1,5	2	3	4	6	8	12	16	24	32	48	64	96	128	192	256
Amoxicillin	9,30	9,30										1							*3*
Ampicillin	11,43	11,43								2		1		1					
Cefotaxime	0	0																	
Ceftriaxone	0	0																	
Gentamicin	0	0																	
Nalidixic acid	0	0																	
Ciprofloxacin	0	0																	

The empty boxes corresponds to no MIC recorded to these concentration. Number in bold: number of strains presenting a MIC inferior or equal to the smallest tested concentration. The shaded areas correspond to the MICs of the strains considered non-wild by EUCAST. Number in italics: number of strains with a MIC greater than or equal to the highest concentration tested. https://mic.eucast.orgEucast2/SearchController/regShowAll.jsp?Title=*Salmonella*%20spp.

4. Discussion

The poultry sellers (poultry slaughterers) are all men in their majority aged less than thirty years with a low level of education. Similar results were found by Kagambega in Burkina Faso: 100% of men aged from 15 to 50 years [18] Cardinal in Senegal that found 100% of men with average age of 38 [19]. Our results have shown that workers in the slaughtering of poultry presented a bad hygiene and a lack of awareness in general hygiene. In Niger, the evisceration of poultry and the gathering visceral tractus are done with hands whith the highest risk of contamination by *Salmonella* (MEAD, 1980). The scalding by immersion in water has been associated to a risk of contamination by *Salmonella* for a long time. All these problems have been raised in other studies [18-20]. Microbiological analysis of poultry slaughtering permitted to find case prevalence between 20% and 69%. Recent studies have shown that poultry are sources for *Salmonella*. Prevalence found by these studies are respectively 52% in Ivory Coast, 37% in Burkina Faso and 33% in Ibadan, Nigeria. Several factors can intervene in transmitting the *Salmonella*. In fact, it has proved that flies (*Musca domestica L.*) are agents of carrying and dissemination of *Salmonella* in poultry and products derived from birds. In addition, there is a pathology related to poultry called aviary salmonellosis.

Biochemical analysis of 35 isolates of *Salmonella* resulted in two (2) classes that differed mainly in Inositol (INO^+) degradation. Group 1 is formed by 94.29% isolates. This metabolic homogeneous dominance that charactizes the majority of isolates (INO^+) and (INO^-) of poultry states a genetic stability of *Salmonella* non specific host over the time and in different types of identical samples: *S.* Derby, *S.* Typhimurium, *S.* Enteritidis, and *S.* Infantis [21].

Concerning the serotyping of isolated *Salmonella* of poultry offal, it was observed eight circulating serotypes. The predominance of serotypes varied between 42.37% for *S.* Derby *S.* to 1.69% for *S.* Hessarek and for *S.* Kissangani, each; however 16.95% of isolates of *Salmonella* Spp were not serotyped. The major serotypes were identical to those found in Burkina Faso: *S.* Derby 14.57%, *S.* Chester 8.86%, *S.* Hato: 6.29% [22]. Contrarily to our results, in Nigeria, the most predominant isolated serotypes of poultry were *S.* Kentucky (16.2%), *S.* Poona (5.66%), *S.* Elizabethville (4.04%) and Larochelle/*S.* Agama (3.77%) [23]. In Chad, the most frequent isolated laying chicken and pulpit chicken were *S.* Colindale (19%) followed by *S.* Minnesota (18%) *S.* Havana and *S.* Riggil (6% each), *S.* Kottbus and S. Amager (4.7%), *S.* Idikan, *S.* Mississippi and *S.* Muenchen (3.6%)[24]. In Algeria, the most frequently isolated serotypes from meat of cheats poultry and avicole products were *S.* Enteritidis (21.24%), *S.* Heidelberg (13.04%), *S.* Infantis, *S.* Ohio, *S.* Altona (8.69% each) [25]. In this study no *Salmonella* Enteritidis, *S.* Kentucky and *S.* Hadar were found despite that the most predominant serotypes found from poultry in Africa [26]. The study about human infections due to *Salmonella* in Niger, has showed that the predominant serotypes were respectively *S.* Paratyphi A, *S.* Paratyphi B, *S.* Typhimurim, *S.* Typhi, *S.* Paratyphi C, *S.* Poona, *S.* Paratyphi C, *S.* Bredeney, *S.* Chester and *S.* Derby [27, 1]. This suggest that even if the poultry offal can be contaminated during the evisceration, they were not the main cause leading to infections of *Salmonella* to human being.

The sensibility study of isolated strains of poultry towards antibiotics has showed a variable antibacterial activity that didn't reach (100%) with the majority of isolates. Kagambéga et *al.,* 2013*,* did the same remark where most of the strains of *Salmonella* were sensible to 12 tested antibiotics [22]. Only 10% of *Salmonella* isolated show multiresistance. Five profiles of MDR *Salmonella* have been found. Two *S.* Derby are resistant to two antibiotics (AMP, CST and AMP, AMC). One *S.* Derby and one S. Hessarek are resistant to three antibiotics (AML, AMC, CST and AMP, AML, CST). One *Salmonella* spp was found to be resistant to four antibiotics (AMP, AML, AMC, CST). These results are very clost those found by Kagambéga et *al.,* 2013 [22].

In this study a resistance of 45% to colistin has been observed. The measure of CMI (E-TEST®) should be done in order to confirm the sensibility or the resistance of these strains to colistin. Results of a study conducted in Brazil have shown that Kirby-Bauer method (The disk-diffusion agar method that tests the effectiveness of antibiotics) is not the most recommend to evaluated the durability to colistin. In

this study the authors have found 21% *S. enterica* strains resistant to colistin Kirby-Bauer method against 4% of resistance when the CMI has been used [16]. Other studies have described bad results using the diffusion method on disk to detect the resistance to colistin [28].

5. Conclusion

A high prevalence of *Salmonella* has been identified in this study. The lack of hygiene but also the poor practices in the dealing of poultry offal can be one of the contamination source from *Salmonella*. The results of the evaluation to the sensibility to antibiotics have showed weak resistance to antibiotics of isolated strains of poultry. However, there is a high risk of contamination of these potentially pathogenic germs in humans.

From these facts measures of sensitization and training are necessary with regard to poultry butchers and sellers about the issues of sanitary security of aliments, environmental and personal hygiene. Nigerien authorities could build slaughter houses and markets of poultry to reduce risks of infectious diseases proliferation such as gastroenteritis and alimental toxi-infection.

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