OPEN ACCESS International Journal of Meat Science

ISSN 2071-7113
DOI: 10.3923/ijmeat.2022.1.11

Research Article
Knowledge and Perception of Butchers/Meat Sellers in Tema, Ghana on Microbiological Meat Safety, Antibiotic Resistance and Residues

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Abstract

Background and Objective: Adherence to meat safety among butchers/meat sellers is essential to prevent meat borne diseases to protect public health. This study was conducted to assess the knowledge and perception of butchers/meat sellers in the Tema metropolis on microbiological meat safety, antibiotic resistance and antibiotic residues. **Materials and Methods:** A descriptive survey design using the semi-structured questionnaire was used to collect data from 278 butchers/meat sellers on their knowledge and perception of meat safety. **Results:** Most of the butchers/meat sellers were males (75%), between the ages of 21-40 years (46%) and had no formal education (51%). The butchering of animals and selling of meats was done on a full-time basis (95%) and COVID-19 had a negative impact (58%) on their business, especially they experienced low sales (63%). The butchers/meat sellers had heard about microbiological meat safety (71%) mostly from health officers (53%). They had also heard about antibiotic resistance (52%) and antibiotic residues (51%) mostly from health officers (76% and 60%, respectively). The butchers/meat sellers knew that meat can be contaminated with bacteria/germs by poor handling and can cause foodborne diseases (62%). Most of the butchers/meat sellers did not know that antibiotic residues are molecules that remain in meat from animals that have been treated with antibiotics (51%) and antibiotic residues can be transferred from meat to humans via consumption (60%). **Conclusion:** The butchers/meat sellers have heard about microbiological meat safety, antibiotic resistance and antibiotic residues but had relatively fair knowledge and perception about them.

Key words: Antibiotics, butchers, Ghana, meat safety, meat sellers, residues, resistance

Citation: Anachinaba, I.A., F. Adzitey, C.A. Brown and E.F. Boateng, 2022. Knowledge and perception of butchers/meat sellers in Tema, Ghana on microbiological meat safety, antibiotic resistance and residues. Int. J. Meat Sci., 12: 1-11.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Butchers buy live animals, slaughter and/or sell the carcass to consumers, while meat sellers are solely involved in the selling of meats[1]. The role of butchers and meat sellers in microbiological meat safety, transfer of antibiotic resistances and deposition of antibiotic residues in meat cannot be overemphasized. The activities they performed in the slaughtering of animals and selling of meats are channels through which meats are contaminated by biological, chemical and physical contaminants[2,3]. Biological contaminants could involve the transfer of antibiotic-resistant bacteria from meat to humans via consumption[4-6]. Chemical contaminants could come from the slaughtering of animals on antibiotic treatments or treatment of meats with certain chemicals to preserve them[4,7-10]. Physical contaminants such as broken bones, insects, hair, plastics or particles of metal can also contaminate meat and pose health risks upon consumption[8,11].

Microbiological meat safety is ensuring that meats are relatively free from microbial contamination. This is important to prevent the occurrence of diseases and the spread of pathogenic organisms in humans. The contamination of meats by pathogenic organisms such as *Escherichia coli* 0157: H7, *Salmonella enterica*, *Campylobacter jejuni*, *Staphylococcus aureus* and *Listeria monocytogenes* have been reported[12-17]. Antibiotic resistance occurs when medicines that kill or destroy microorganisms are unable to do so[18]. There is evidence that some microorganisms of meat origin were resistant to several antibiotics including ampicillin, ciprofloxacin, erythromycin, penicillin, tetracycline among others[12,16,19-20]. Antibiotic resistance in particular has emerged to be one of the leading causes of death in humans worldwide. Antimicrobial Resistance Collaborators[21] stated that antimicrobial resistance poses a significant threat to mankind, killing about 3500 people each year. Also, estimates pointed out that more than 1.2 million people died as a result of direct antibiotic-resistant bacterial infections[21]. Antibiotic residues are metabolites present in trace amounts in meats mostly after antibiotic administration[22]. Excess amounts of antibiotic residues in meat can contribute to the development of resistance in humans and animals[10]. Various types of meats have been demonstrated to contain antibiotic residues such as amoxicillin, tetracycline, ciprofloxacin, danofloxacin, doxycycline, norfloxacin, tylosin etc[23-26].

Butchers'/meat sellers' knowledge and perception of meat safety and their demand for it could make farmers and all stakeholders practice organic and sustainable animal production. Nonetheless, studies on the knowledge of butchers/meat sellers in Ghana on microbial meat safety, antibiotic usage and antibiotic residues are limited and unavailable in most regions. The city of Tema is cosmopolitan with people from different parts of the world and actively involved in meat consumption. The city is also an industrial hub in Ghana and contributes significantly to the economy of Ghana. The menace of antibiotic resistance can lead to higher cost of medical treatment, prolong hospitalization, reduce manpower and increase mortality[18]. Therefore, this study was conducted among butchers/meat sellers in Tema, Ghana to determine their knowledge and perception of microbial meat safety, antibiotic usage and antibiotic residues.

MATERIALS AND METHODS

Study area: The study was conducted in Tema Metropolis, Ghana from April-September, 2020. The Metropolis lies between latitude 5°38'32' North and longitudes 0°0'9' West and has a population of 29, 2773[27]. The map of Ghana and Tema Metropolis (in yellow) where this study was conducted (Fig. 1).

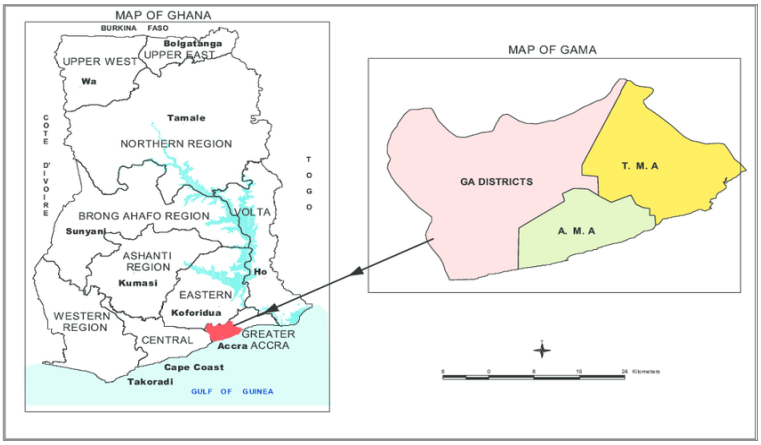

Fig. 1: Map of Ghana, Greater Accra Metropolis and Tema Metropolis (in yellow)

Ethics: The consent of the respondents was sought and only those willing to take part were interviewed. Furthermore, the respondents were assured of their confidentiality.

Data collection: A survey was conducted among butchers/meat sellers on their demographic characteristics, knowledge and perception of meat safety, antibiotic usage/resistance and antibiotic residues. The respondents were selected using a simple random design. A semi-structured questionnaire made up of both close and open-ended questions was used to obtain information from the respondents. Sample size determination was done according to Bartlett *et al.*[28]. The population of butchers/meat sellers in Tema was 995 (personal communication with Tema Butchers/Meat sellers Association). Based on this population the sample size was computed to be 278 and the same were interviewed.

Data analysis: Data collected were subjected to analysis using Statistical Package for Social Sciences version 20, Armonk, NY. Chi-square (χ^2) was used to determine the relationship among some of the data obtained at 5%.

RESULTS AND DISCUSSION

Demographic characteristics and information about butchers/meat sellers: The demographic characteristics of butchers/meat sellers can be found in Table 1. The majority of the butchers/meat sellers were males (75%) and between the ages of 21-40 years (46%). The majority were also single (69%), were Christians (42%) and had no formal education (51%). The majority of the respondents were both butchers and meat sellers (65%) and had more than 10 years of experience in butchering and selling meats as can be observed in Table 2. Mutton (27%), beef (25%), chicken (22%), chevon (15%) and pork (10%) were the meats mostly sold by the meat sellers. They sold these meats because of profit (44%) and based on consumers' preferences (39%). The respondents were mainly involved in butchering/selling of meats business on a full-time basis (95%). COVID-19 harmed their business, especially in the areas of poor sales/low patronage (63%) and low supply of animals (28%).

This study revealed that the butchers/meat sellers were dominated by males, youth, single, Christians and people with non-formal education. Similar observations were made by Sulleyman *et al.*[2] in Accra and Adzitey *et al.*[29] in Tamale among meat sellers except for the percentage of Muslims involved in meat selling, which was higher in the study of Sulleyman *et al.*[2] and Adzitey *et al.*[29] compared to the current study. The majority were also both butchers and meat sellers and sold mutton, beef, chicken, chevon and pork based on consumers' preference and for profit. The study also depicted that most of the butchers/meat sellers had more than ten years of experience in the butchering/selling of meat business and did that on a full-time basis. Adzitey *et al.*[29] also reported that the majority of meat sellers sold beef (62%), on a full-time basis (85%) and had more than 10 years of experience as meat sellers. COVID-19 harmed their business in that they made poor sales. Age ($\chi^2 = 674.467$, df = 42, p = 0.000), education ($\chi^2 = 744.053$, df = 42, p = 0.000) and years of experience in butchering/meat selling ($\chi^2 = 674.865$, df = 42, p = 0.000) influenced the impact of COVID-19 on the butchering and meat selling business. COVID-19 was found to negatively impact the activities of cold chain operators and butchers in Ghana by Monten[30] and Adzitey *et al.*[1], respectively.

Knowledge and perception of butchers/meat sellers on microbiological meat safety: The butchers/meat sellers had heard about microbiological meat safety (71%) mostly from health officers (53%) and the media (38%) as can be seen in Table 3. The majority of the butchers/meat sellers knew that meat can be contaminated with bacteria/germs by poor handling and can cause foodborne diseases (62%), eating, drinking and smoking while selling meat increases the risk of

Table 1: Demographic characteristics of meat sellers/butchers

Variables	Frequency	Percentage (%)
Gender		
Male	209	75
Female	69	25
Age (years)		
Below 21	34	12
21-40	129	46
41-60	86	31
Above 60	29	10
Marital status		
Married	72	26
Single	187	69
Divorced	6	2
In a relationship	7	3
Religion		
Christianity	116	42
Islamic	106	39
Traditional	53	19
Educational background		
None	142	51
Basic	98	35
Secondary	32	12
Tertiary	5	2

Table 2: Information about butchers/meat sellers on butchering/meat selling

Variables	Frequency	Percentage (%)
Meat seller	24	9
Butcher	72	26
Both	182	65
Length of butchering/selling meat		
Less than 1 year	16	6
1-5 years	80	29
6-10 years	56	20
Above 10 years	126	45
Type of meat sold		
Beef	70	25
Chicken	61	22
Pork	27	10
Mutton	76	27
Chevon	42	15
Fish (mentioned as others)	2	1
Reason for type of meat sold		
Profitable	121	44
Consumer preference	109	39
Personal choice	22	8
Family business	16	6
Religious reasons	10	4
Butchering/sell meat as a full or part-time job		
Part time	15	5
Full time	263	95
Impact of COVID-19 on your butchering activities and business		
Very negative	92	33
Negative	161	58
Neutral	20	7
Positive	2	1
Very positive	3	1
Aspect of your business affected most by COVID-19		
Poor sales/low patronage	138	63
Low supply of animals	78	28
High cost of animal	23	8

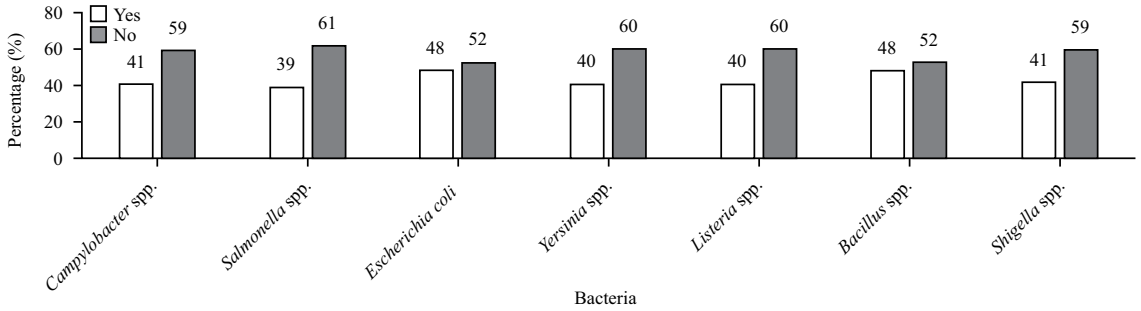

Fig. 2: Bacteria that cause foodborne diseases-butchers/meat sellers response

its contamination (61%) and observance of meat hygiene by meat sellers/handlers reduces the risk of meat contamination (66%). According to the butchers/meat sellers, the best method for preserving meat is refrigeration (60%), followed by drying (23%). The reason is that these methods are appropriate (44%), cost-effective (40%) and safe (16%). The butchers/meat sellers had seen animals being slaughtered (63%) and did not like it (64%). Butchers/meat sellers preferred buying their meat from butcher shops (42%), open markets (35%) as well as supermarkets (15%) and considered the price (58%) as well as the neatness of the place (32%). Figure 2 shows that farmers knew some bacteria such as *E. coli*(48%), *Bacillus* spp. (48%), *Campylobacter* spp. (41%), *Shigella* spp. (41%), *Listeria* spp. (40%), *Yersinia* spp. (40%) and *Salmonella* spp. (39%) can cause foodborne diseases.

Table 3: Knowledge and perception of butchers/meat sellers on microbiological meat safety

Variables	Frequency	Percentage (%)
Have you ever heard of microbiological meat safety?		
Yes	198	71
No	80	29
If, yes from who/where?		
Health officer	104	53
Teacher/school	18	9
Media	76	38
Meat can be contaminated with bacteria/germs by poor handling and can cause foodborne diseases		
Yes	165	62
No	103	38
Eating, drinking and smoking while selling meat increases the risk of its contamination		
Yes	162	61
No	104	39
Observance of meat hygiene by meat sellers/handlers reduces the risk of meat contamination		
Yes	174	66
No	89	34
Best method to preserve meat to reduce/prevent contamination		
Refrigeration	167	60
Salting	19	7
Smoking	28	10
Drying	63	23
Why did you choose this method?		
Appropriate method	123	44
Cost effective	110	40
Safe	45	16
Seen how animals are slaughtered and dressed before being sold on the market		
Yes	176	63
No	102	37
If yes, did you like it?		
Yes	84	36
No	152	64
Where do you buy your meat?		
Open market	112	42
Butcher shop	93	35
Super market	39	15
Cold store	6	2
Abattoir	14	5
Why do you buy meat from such a place?		
Price of the meat	147	58
Neatness of the place and meat	82	32
Closeness to my house	9	4
Friendliness of the seller	15	6

The study revealed that most butchers/meat sellers had heard about meat safety and heard about it from health officers, the media and schools. More so, most of the butchers/meat sellers had some knowledge of how meat is contaminated by bacteria, risks associated with certain practices of handling meat and means of reduction of meat contamination. Refrigeration was identified as the best method of preserving meat because it is safe, appropriate and cost-effective. Most of the butchers/meat sellers had seen animals being slaughtered but did not like it. In addition, most of them preferred buying meat from the open market and butcher's shop because of the price and neatness of the place and meat. Age (χ^2 = 664.318, df = 18, p = 0.000), education (χ^2 = 744.053, df = 10, p = 0.000) and years of experience in butchering/meat selling (χ^2 = 681.802, df = 18, p = 0.000) by the butchers/meat sellers influenced their hearing of meat safety. The majority of the butchers/meat sellers interviewed did not know that *Listeria* spp., *E. coli*, *Shigella* spp., *Salmonella* spp., *Yersinia* spp., *Bacillus* spp. and *Campylobacter* spp., can cause foodborne diseases. Foodborne pathogens are one of the important sources responsible for morbidity and mortality worldwide. Education and training of butchers/meat sellers are necessary to create awareness and to help reduce the risk of transfer of these pathogens from animals to their carcasses during slaughtering and meat selling. Adzitey *et al.*[30] found that education had a

Table 4: Knowledge and perception of butchers/meat sellers on antibiotic resistance

Variables	Frequency	Percentage (%)
Heard of antibiotic resistance		
Yes	145	52
No	133	48
If, yes by who/where?		
Health officer	142	76
Teacher/school	14	7
Media	32	17
Ever taken or used antibiotics		
Yes	123	48
No	132	52
Why did you use this/these antibiotics?		
To treat infection	63	51
To treat injury	50	41
Others (sore throat, body pains)	10	8
If you have never used antibiotics, why?		
No one has ever prescribed antibiotics to me	65	50
No knowledge	52	40
Never been sick	12	9
Antibiotics have effects on humans		
Yes	121	68
No	56	32
If yes, what do you think are the effects of antibiotic usage?		
Nausea and allergies	43	36
Body reaction and pains	41	34
No idea	37	31
Animals on antibiotics are sometimes slaughtered for sale?		
Strongly agree	51	21
Slightly agree	45	19
Moderately agree	46	19
Slightly disagree	43	18
Strongly disagree	56	23

significant association with the hearing of meat safety among butchers. Adesokan and Raji[31] reported that educational level had a significant association with knowledge, attitude and practice of meat safety among meat handlers. The finding of refrigeration as the best method of meat preservation in this study is also consistent with the findings of Adzitey *et al.*[32] on the handling and storage of leftover meat by butchers in the Tamale Metropolis and Bolgatanga Municipality of Ghana.

Knowledge and perception of butchers/meat sellers on antibiotic resistance: The knowledge and perception of butchers/meat sellers on antibiotic usage are shown in Table 4. The butchers/meat sellers had heard about antibiotic resistance (52%) from health officers (76%) and had ever taken or used antibiotics (48%) to treat infections (51%) and injury (41%). The antibiotics ever used by butchers/meat sellers are presented in Fig. 3a. They were amoxicillin/clavulanic acid (66%), ciprofloxacin (50%), teicoplanin (47%), chloramphenicol (46%), tetracycline (43%), ceftriaxone (42%), gentamicin (37%), azithromycin (37%) and sulphamethoxazole/trimethoprim (36%). Those who had never used antibiotics stated that no one has ever prescribed antibiotics to them (50%), do not know antibiotics (40%) and have never been sick (9%). The butchers/meat sellers also knew that antibiotics have effects on humans (68%). Such effects include nausea and allergies (36%) as well as body reaction and pains (34%). Most of the butchers/meat sellers agreed (59%, slightly to strongly agree) that animals on antibiotics are sometimes slaughtered for sale. Generally, 67% of the butchers/meat sellers disagreed (slightly to strongly disagree) that locally produced meats on the Ghanaian market sometimes contain antibiotic-resistant bacteria (Fig. 3b), while 59% of them disagreed (slightly to strongly disagree) that imported meats on the Ghanaian market sometimes contain antibiotic-resistant bacteria (Fig. 3c).

This study showed that most of the butchers/meat sellers had heard about antibiotic resistance mostly from health officers. Close to half of the butchers/meat sellers interviewed had ever used antibiotics such as chloramphenicol, ceftriaxone, tetracycline, teicoplanin and gentamicin, ciprofloxacin, amoxicillin/clavulanic acid, azithromycin and sulphamethoxazole/trimethoprim to treat infections, injuries,

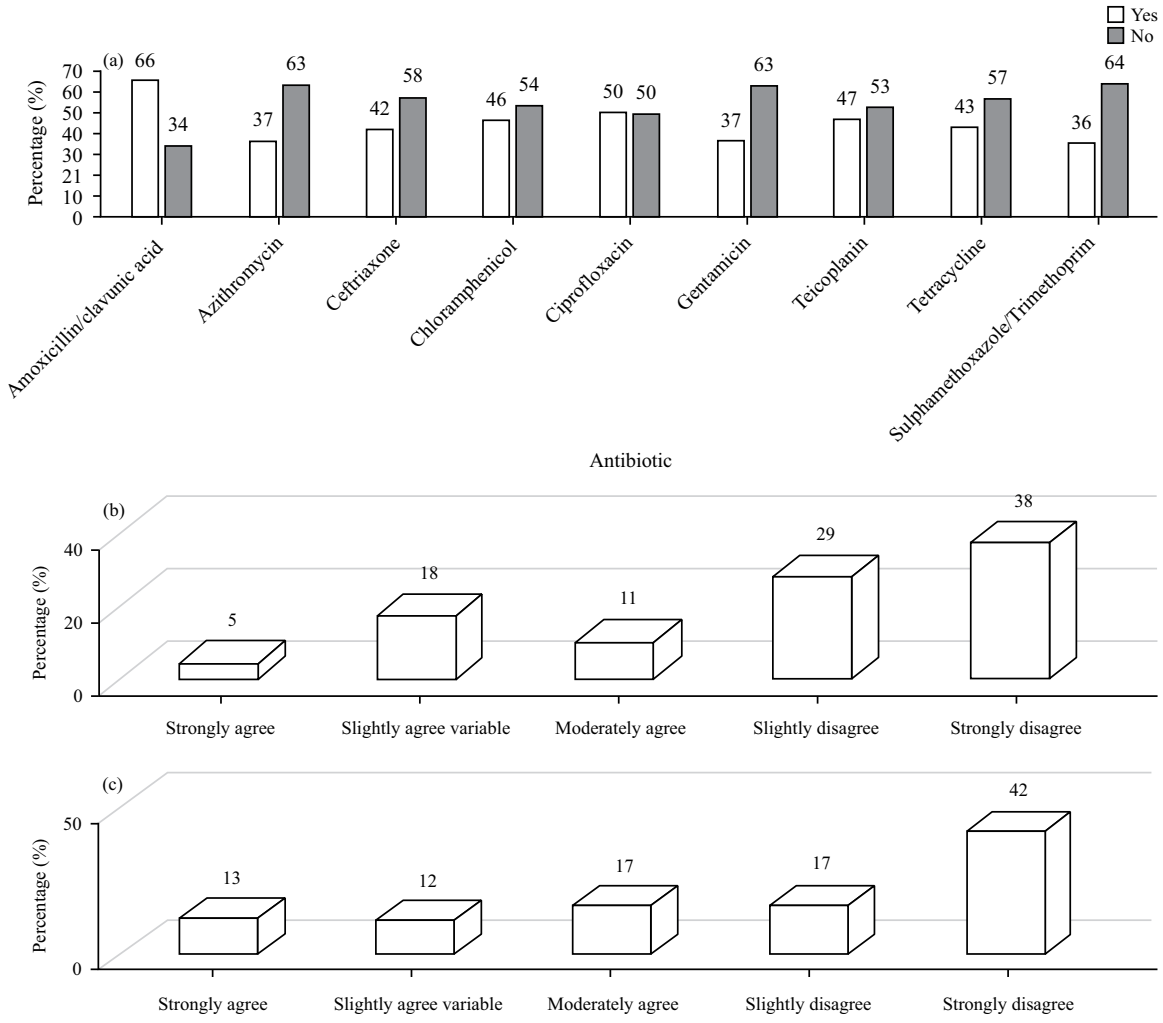

Fig. 3(a-c): Knowledge and perception of butchers/meat sellers on (a) antibiotic usage and antibiotic resistant bacteria in (b) local and (c) imported meats

sore throat and body pains. Those who had never used antibiotics before ascribed that to the fact that, they had never been sick, did not know antibiotic usage or it had never been prescribed for them. The majority of the butchers/meat sellers ascertained the fact that antibiotic usage has negative effects such as nausea, allergies, body reactions and pains. Among the butchers/meat sellers, animals on antibiotics are sometimes slaughtered for sale. However, the majority disagreed that locally produced and imported meats in Ghana sometimes contain antibiotic-resistant bacteria. Age (χ^2 = 672.844, df = 30, p = 0.000), education (χ^2 = 719.214, df = 30, p = 0.000) and years of experience in butchering/meat selling (χ^2 = 695.676, df = 30, p = 0.000) by the butchers/meat sellers influenced their knowledge in antibiotic resistance. The development of antibiotic resistance is a global phenomenon affecting all stakeholders including butchers. Antibiotics are normally used to treat bacteria and their related infections[33-34]. According to Katakweba *et al.*[35], when poultry farmers were asked about the possible effects of antibiotics on human health, they mentioned common effects such as death, body swellings, diarrhoea, itching, poison to humans, the resistance of bacteria to drugs, skin rashes, stomach problems and vomiting, some of which are consistent with the responses from respondents of this study.

Knowledge and perception of butchers/meat sellers on antibiotic residues: The knowledge and perception of butchers/meat sellers on antibiotic residues are presented in Table 5. Most of the butchers/meat sellers had heard about antibiotic residues (51%). They heard of antibiotic residues from health officers (60%), teachers (13%), their colleagues (12%) and the media (11%). Most of the butchers/meat

Table 5: Knowledge and perception of butchers/meat sellers on antibiotic residues

Variables	Frequency	Percentage (%)
Heard of antibiotic residues		
Yes	126	51
No	121	49
If, yes by what means		
Health officer	75	60
Teacher/school	16	13
Media	14	11
Observation of meat	6	5
Colleagues	15	12
Antibiotic residues can occur in humans		
Yes	76	27
No	65	23
I do not know	137	49
Antibiotic residues can occur in bacteria/germs		
Yes	75	27
No	66	24
I do not know	137	49
Antibiotic residues are molecules that remain in meat from animals that have been treated with antibiotics		
Yes	74	27
No	62	22
I do not know	142	51
Antibiotic residues in meat can be reduced by observing withdrawal periods		
Yes	65	23
No	54	19
I do not know	159	57
Antibiotic residues can be transferred from meat to humans via consumption		
Yes	62	22
No	48	17
I do not know	168	60
Animal farmers play a significant role in antibiotic-resistant residues in meat		
Yes	104	37
No	46	17
I do not know	128	46

sellers did not know that: (1) antibiotic residues can occur in humans (49%), (2) antibiotic residues can occur in bacteria/germs (49%), (3) antibiotic residues are molecules that remain in meat from animals that have been treated with antibiotics (51%), (4) antibiotic residues in meat can be reduced by observing withdrawal periods (57%), (5) antibiotic residues can be transferred from meat to humans via consumption (60%) and (6) animal farmers play a significant role in antibiotic-resistant residues in meat (46%). The butchers/meat sellers have heard of the following antibiotic residues: Amoxicillin (62% butchers/meat sellers), chlortetracycline (52% butchers/meat sellers), ciprofloxacin (52% butchers/meat sellers), danofloxacin (47% butchers/meat sellers), doxycycline (44% butchers/meat sellers), norfloxacin (55% butchers/meat sellers), oxytetracycline (41% butchers/meat sellers), sulfadiazine (38% butchers/meat butchers/meat sellers), tylosin (47% butchers/meat sellers), chloramphenicol (39% butchers/meat sellers) and metronidazole (38% butchers/meat sellers) in Fig. 4a. In addition, 53% of the butchers/meat sellers disagreed (slightly to strongly disagree) that locally produced meats on the Ghanaian market sometimes contain antibiotic residues (Fig. 4b), while 55% of them agreed (slightly to strongly agree) that imported meats on the Ghanaian market sometimes contain antibiotic residues (Fig. 4c).

This study revealed that most the butchers/meat sellers had heard about antibiotic residues such as Amoxicillin, chlortetracycline, ciprofloxacin, danofloxacin, doxycycline, norfloxacin, oxytetracycline, sulfadiazine, tylosin, chloramphenicol and metronidazole mostly from health officers. However, most of them did not know that antibiotic residues can occur in humans, bacteria and meats from faulty usage of antibiotics and consumption of meats. The majority

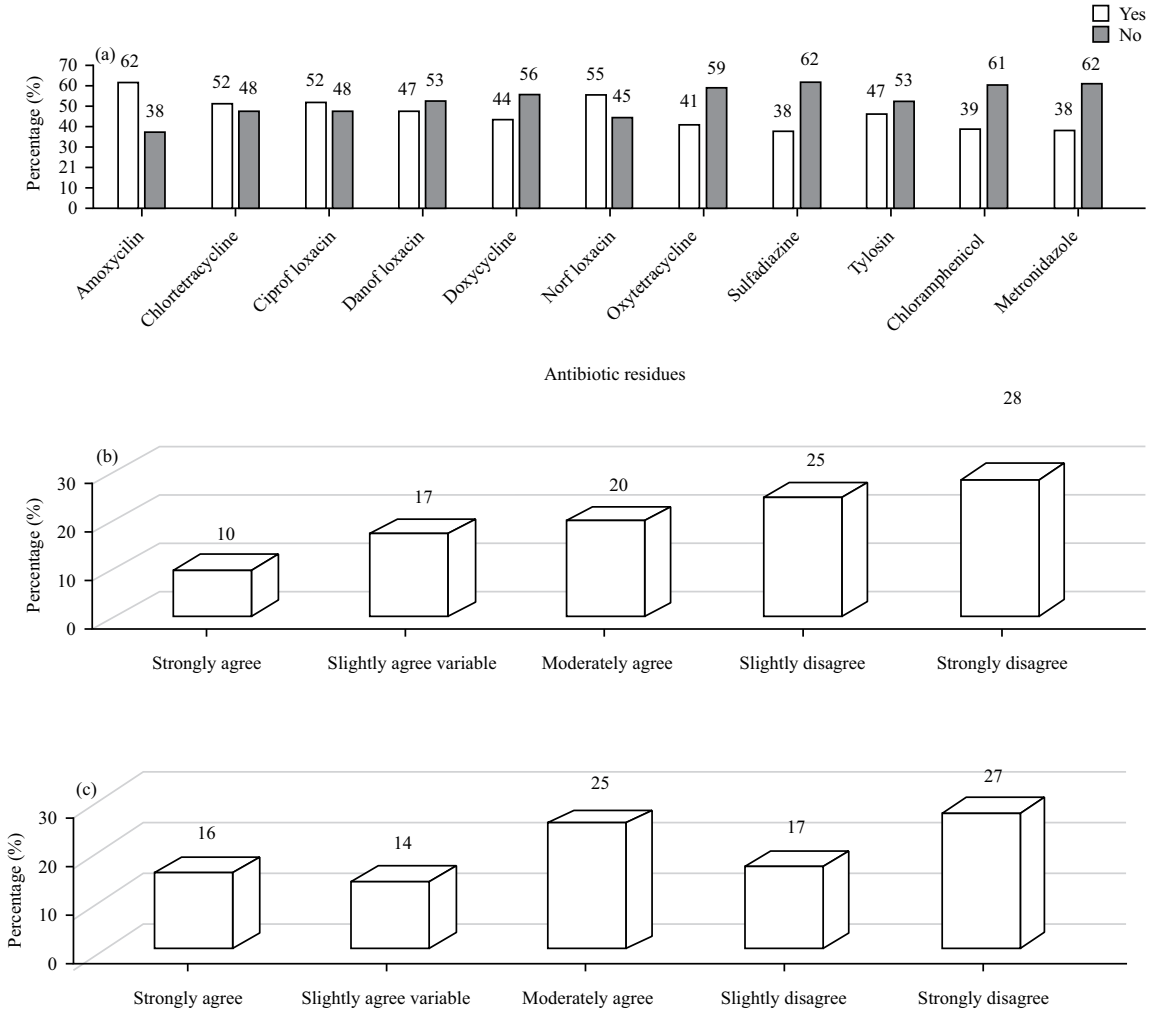

Fig. 4(a-c): Knowledge and perception of butchers/meat sellers on (a) antibiotic residues and their presence in (b) local and (c) imported meats

of them also did not know that withdrawal periods can reduce the occurrence of antibiotic residues in meats and that farmers play a key role in the deposition of antibiotic residues in meats. Most of the farmers disagreed that locally produced meat contained antibiotic residues but not imported meats. Age ($\chi^2 = 673.186$, df = 24, p = 0.000), education ($\chi^2 = 722.220$, df = 24, p = 0.000) and years of experience in butchering/meat sellers ($\chi^2 = 696.855$, df = 24, p = 0.000) of the butchers/meat sellers influenced their knowledge in antibiotic residues. Antibiotic residues occur in meats when farmers treat animals with antibiotics and withdrawal periods for these antibiotics are not observed before slaughtering. Poultry farmers mentioned that one of the effects of using antibiotics is the occurrence of drug residues in animal products[35]. Butchers can contribute to reducing this incidence by asking for the health status and treatment history of animals before purchase and slaughter.

CONCLUSION

The majority of the butchers/meat sellers were males, young and had no formal education. Butchering and meat (beef, chevon, chicken, mutton, pork) selling was mainly done on a full-time basis and COVID-19 harmed their business. Most butchers/meat sellers had heard about microbiological meat safety, antibiotic resistance and antibiotic residues. Most of the butchers/meat sellers disagreed that locally produced and imported meats on the Ghanaian market sometimes contain antibiotic-resistant bacteria. Most of the butchers/meat sellers disagreed that locally produced meats on the Ghanaian market sometimes contain antibiotic residues but agreed on the same for locally produced meats. Education of butchers/meat sellers on antibiotic usage and its consequences is warranted as it will contribute to reducing the spread of antibiotic resistance.

SIGNIFICANCE STATEMENT

Antibiotic resistance and residues hurt human health, such as leading to prolong or fail treatment regimes, allergies, mutation of cells and sometimes death. Key to the acquisition of antibiotic resistance and residues is the use of antibiotics in animal farming, faulty slaughtering/processing and selling of meat under unhygienic conditions. Therefore, hygienic slaughtering and selling could contribute to reducing the menace of antibiotic resistance and residues. Knowledge and perception of butchers/meat sellers in microbiological meat safety, antibiotic usage/resistance and antibiotic residues will help stakeholders to know areas where education is needed since butchers/meat sellers can play significant roles in reducing the menace of multi-resistant germs and deposition of antibiotic residues that pose threat to human life.

ACKNOWLEDGMENTS

The authors are grateful to the butchers/meat sellers who willingly took part in this survey. The authors also acknowledge the staff of Tema Food and Drugs Authority for their assistance with data collection.

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