

Full Length Research Paper

Assessment of operational facilities and sanitary practices in Zangon Shanu abattoir, Sabon Gari Local Government Area, Kaduna State, Nigeria

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A descriptive cross-sectional study was conducted to assess the operational facilities and sanitary practices in Zangon Shanu abattoir, Kaduna State, Nigeria. Semi structured questionnaires were administered to the workers and also observational studies on facilities and sanitary practices in the abattoir were conducted. The results showed that 75.00% of the abattoir workers were between the ages of 25 to 35 years, with majority ($P<0.05$) not well educated. Also 60.00% of the workers are working in the abattoir for more than 6 years ($P<0.05$), with only 40.00% were well trained on abattoir operations. Observational assessment of abattoir facilities revealed that the size and sitting of the abattoir were very satisfactory, however not cited close to livestock market. Facilities such as lairage, evisceration section, guttery and tripery section, cold room, detained meat section and condemned meat section are present but non-functional. There is ample supply of water from the overhead tank and also hand pump borehole. Most of the solid wastes (bones, horns and undigested ingesta) were packed in sacks and transported out of the abattoir for other uses, while the rests were burnt in the abattoir and the ashes packed for other uses. Liquid wastes was normally done manually by sweeping with brooms and directed into the drainage system which was opened into the nearby stream and bush. All blood from the slaughtered animals were collected into containers, boiled and taken out of the abattoir for other uses. Cleaning and disinfection of the slaughter slabs, premises and floors were done daily and the wastewater and its effluents directed into drainage. The study recommends renovation of some facilities; provision of sanitary sections with well-equipped facilities and provision of bins and dumpsites for proper disposal of wastes.

Key words: assessment, operational facilities, sanitary practices, solid and liquid wastes, Zagon Shanu abattoir.

INTRODUCTION

An abattoir or slaughter house is a place where animals are slaughtered or killed for human consumption (Bello and Oyedemi, 2009; Lawan et al., 2013). The most

commonly slaughtered animals for food are cattle, sheep, pigs, goats, and fowls, for poultry meat. The practice of slaughtering livestock and its resultant meat supply also

provides very useful by-products such as skin and leather (Komba et al., 2012). A standard abattoir should have the following components; lairage, slaughter hall, slaughter slab, gut and tripe section, detained meat section, offal section, condemned meat section, water supply and cold room. Others are; hide and skin section, veterinary inspection section, sanitary section, veterinary office, laboratories and wastes disposal facilities. Inadequate abattoir facilities affect the daily operations leading to the production of unsafe and unwholesome meat and meat products for human consumption.

Adequate and proper abattoir operations such as ante-mortem inspection, slaughtering, bleeding, evisceration, post-mortem inspection, and waste disposal are important in the production and supply of wholesome meat for human consumption (Alhaji and Bawa, 2015; Richard et al., 2015). This can only be achieved by the presence of adequate, standard and functional operating facilities, proper sanitary conditions and good hygiene practices (Alhaji and Bawa, 2015). Lack of standard facilities coupled with non-adherence to good manufacturing practices, good hygienic practices and sanitary practices in abattoirs and slaughterhouses in developing countries, especially in Nigeria, were attributed to meat contamination and poor waste disposal with resultant effects on the environmental and human health in general (Alhaji and Bawa, 2015; Richard et al., 2015).

An abattoir has been identified as a facility or place approved and registered for slaughtering and dressing of animals for human consumption should therefore, have equipment for slaughtering, holding, processing, storing and distributing the carcass (Dandago et al., 2009). However, this responsibility has been neglected by mostly the local authorities which are the sole managers of abattoirs and slaughterhouses in Nigeria. This resulted in the deteriorating conditions of most facilities and the sanitary conditions, improper conduct of meat inspection, inadequate hygienic processes which are having negative effects on public health (Nwanta et al., 2008; Ezeohaa and Ugwuishiwu, 2011). In most abattoirs and slaughterhouses, operating facilities are absent; there are also lack of sewage and waste disposal systems, no provision of potable water, no cold storage system and toiletry facilities for staff and workers (Adeyemo, 2002; Lawan et al., 2013; Akpabio et al. (2015). These conditions are important in protecting human lives and preventing the spread and transmission of diseases through the consumption of contaminated meat (Dandago et al., 2009). Adequate sanitary conditions, wastes disposal and proper hygiene practices are steps that can be taken to control the chances for meat

contamination (Komba et al., 2012; Richard et al., 2015).

However, most abattoirs in Nigerian did not meet this standard because of improper sanitary practices such as burning of animals with car tires, disposal and burning of solid wastes in the premises and lack of environmental sanitation (Ezeohaa and Ugwuishiwu, 2011; Nafada et al., 2012; Douglas et al., 2013). This study was therefore conducted to assess the availability and functional status of abattoir facilities, and also the sanitary practices in Zango Shanu abattoir of Sabon-Gari Local Government Area, Kaduna State.

MATERIALS AND METHODS

Study area

The study was conducted in Zangon Shanu abattoir located in Zango, Sabon Gari Local Government Area, Kaduna state, Nigeria. The abattoir is owned by the Kaduna State government, and located in Longitude of 70 8' E and between latitude 100 11' N Greenwich meridian of the equator. Animals slaughtered daily at the abattoir comprises of cattle, goats and sheep.

Study design

A descriptive cross-sectional study was conducted using observational study to obtain firsthand information on the status of the facilities and the sanitary conditions of Zangon Shanu abattoir, Sabon Gari local Government Area, Kaduna State. Semi structured questionnaires were also used to obtain information from the manager, identified staff and workers of the abattoir.

Assessment of abattoir facilities

The abattoir was visited during slaughter and operation time (6:00 am to 1:00 p.m.) twice a week for the period of one month, where observational study was conducted on the facilities. The sections, structures and parts of the abattoirs were also assessed based on their availability and functional status. The observed and identified sections and parts were pictured using digital camera to show their status. The status of the facilities was assessed on the basis of either presence or absence, present and functional or present and non-functional.

Assessment of sanitary practices

Assessment of sanitary practices of the abattoir was carried out based on the following parameters; location, presence of a fence, source and availability of potable water, slaughter area and availability of basic facilities, ante-mortem and post-mortem facilities, waste disposal system, presence of toilets and bathrooms, protective clothing for workers, hygienic procedures of workers and the environment.

Data analysis

All data the collected were summarized and entered into Microsoft

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Table 1. Demographic characteristic of the staff and other respondents.

Characteristics	Frequency	Percentage
Gender		
Male	13	65.00
Female	7	35.00
Age (Years)		
18-25	5	25.00
25-35	15	75.00
36 and above	-	-
Level of education		
Primary	1	5.00
Secondary	6	65.00
Tertiary	13	30.00
Meat inspection operation		
Trained	12	60.00
Untrained	8	40.00
Period of work in abattoir		
1-3 years	-	-
4-6 years	8	40.00
Above 6 years	12	60.00

Excel 7 spreadsheet (Microsoft Corp.) and stored. The data were analyzed using Statistical Package for Social Sciences (SPSS) version 20.0. Descriptive statistics were computed to determine the presence or absence and the relationship between the variables. The Chi-square test was used to examine the association between the variables. P value <0.05 was considered statistically significant. The data were presented using frequencies, percentages, pictures and tables.

RESULTS

Questionnaires were administered to all the 20 abattoir workers; which were well responded and returned. The gender, age, level of education and years worked in the abattoir were among the demographic characteristics of the respondents (abattoir staff) assessed. The results showed the 65.00% of the abattoir workers were males, while 35 were females (Table 1). The age group of workers indicated that 75.00% of the abattoir workers were between the ages of 25-35 years, while 25% are between 18-25 years of age ($P<0.05$). Majority of the workers ($P<0.05$) were not well educated, with only 30.00% having tertiary education (Table 1). The results also revealed that 60.00% of the workers are working in the abattoir for more than 6 years while 40.00% are working for less than 6 years ($P<0.05$). The finding also indicated that only 40.00% of the workers were well trained on abattoir operations, while 60.00% were untrained

(Table 1).

Observational and assessment of abattoir facilities revealed that the size and sitting of the abattoir were very satisfactory, however not cited close to livestock market. Citing of abattoir close to livestock market is to prevent long distant travelling and transportation. The walls of the slaughter area are long with adequate ventilation and illumination (Table 2). Facilities such as lairage, evisceration section, guttery and tripery section, cold room, detained meat section and condemned meat section were present but non-functional (Figure 3 and Table 3). There was ample supply of water from the overhead tank and also hand pump borehole (Table 2 and Figure 1), with underground dam for storage of water.

Sanitary practices in the abattoir were observed to be satisfactory despite the absence of sanitary section in the abattoir. The sanitary practices were done manual with the aid of brooms, water, disinfectants and wheelbarrow (Figure 2). The solid wastes (condemn meat, undigested ingesta, bones, horns, hairs and aborted fetuses etc.) were disposed using different procedures. It was observed that 90.00% of the bones and horns were packed in sacks and transported out of the abattoir for other uses (Figures 5 and 6), while the remaining 10.00% were burnt in the abattoir and the ashes packed for other uses (Figure 4). Also 95.00% of the undigested ingesta were packed and transported out of the abattoir for disposal (Figure 6), while the remaining 5.00% of the

Table 2. Observations on facilities and infrastructures.

Facility	Observation
Location and site	(i) The abattoir is close to residential areas (ii) The abattoir has easy access to roads and transportation (iii) The site is not prone to flood
Size	(i) There is adequate space for movement of people and animals (ii) Lairage facility is present but not functional
Constructional materials, walls and floors	(i) Walls were even throughout the structure (ii) There was sloping towards the drains (iii) The roof and walls were smooth and easy to clean
Ventilation	(i) The abattoir is well ventilated because it was not properly enclosed.
Illumination	(i) The abattoir was very open, which allowed sufficient illumination into the working area.
Water supply	(i) The main source of water was from storage overhead tank and hand pump borehole (ii) Water was also stored in underground dam for immediate use.
Sanitary facilities	(i) There was water for cleaning and washing. (iii) Disinfectants were also available for use daily Brooms and wheelbarrow were available for sanitation purposes. (iv) There was no washing rooms or toilets for staff

**Figure 1.** Hand pump borehole as a source of water.

ingested were usually channel through the draining system (Figure 7). Further findings revealed that all the condemned meat and fetuses were burnt around the vacant land in the premises of the abattoir.

The disposal of liquid wastes was normally done manually by sweeping with brooms and directed into the drainage system which was opened into the nearby stream and bush (Figures 2 and 3). All blood from the slaughtered animals were collected into containers, boiled and taken out of the abattoir for other uses (Figure

8), while the water wastes and effluents are swept out into the drainage, from where they are directed out of the abattoir to the nearby bush. The slaughter slabs are cleaned and disinfected daily (Figures 9 and 10), with the wastewater and its effluents (dissolved solid, blood, gut contents, urine and water etc.) directed into drainage (Table 4 and Figures 7 and 11). The premises and the floor of the slaughter slabs are normally cleaned and disinfected after every slaughtering session (Figures 4 and 11).



Figure 2. Brooms and detergent used for sweeping and washing.



Figure 3. Nonfunctional Lairage.



Figure 4. Horns packed before packing out of the abattoir.



Figure 5. Bones packed in sacs ready for transportation.



Figure 6. Undigested ingesta packed for transporting out of the abattoir.



Figure 7. Solid wastes channeled into drainage system.

Table 3. Assessment of abattoir facilities.

Components of abattoir	Remarks
Lairage	Present and non-functional
Slaughter hall or slab	Present and functional
Evisceration section	Present and non-functional
Meat inspection section	Present and functional
Head, feet and skin section	Present and functional
Guttery and tripery section	Present and non-functional
Cold room	Present and non-functional
Detained meat section	Present and non-functional
Condemned meat section	Present and non-functional
Drainage system	Present and functional
Veterinary laboratory	Absent
Water supply	Present and functional
Electricity supply	Absent
Sanitary section	Absent
Blood processing section	Present and functional
Toilets and rest room	Absent
Staff offices	Present and functional
Flaying section	Absent

Table 4. Sanitation practices in the abattoir.

Practices	Frequencies (%)
Disposal of solid waste	
Burning	10.00
Dumping on vacant land or bush	-
Dumping along drainage	-
Packing away from the abattoir	90.00
Frequency of disposal of solid waste	
Daily	100.00
Twice weekly	-
Disposal of liquid waste	
Channel to nearby bush	-
Channel to nearby drainage	100.00
Frequency of cleaning water waste channel	
Daily	100.00
Weekly	-
Monthly	-
Cleaning and disinfection of the abattoir	
Manuel equipment	100.00
Mechanical use	-
Frequency of cleaning and disinfection	
Daily	100.00
Twice weekly	-
Thrice weekly	-



Figure 8. Blood and other liquid wastes channeled out into stream.



Figure 9. Blood placed in buckets before boiling.

DISCUSSION

Adequate facilities and proper sanitary conditions are key factors in the production and distribution of meat in an abattoir as well as prevention of transmission and spread of both human and animal diseases. However, most abattoirs and slaughter houses in developing countries are poorly constructed, lack adequate meat inspection

facilities, lack qualified meat inspectors and also lack proper sanitary practices (Biu et al., 2006). This has some public health implications as it determines the potential for possible transmission of zoonotic diseases from animal or environment to man and vice versa (Tassew et al., 2010). This study assessed the operational facilities and sanitary practices in Zangon Shanu abattoir, Sabon Gari Local Government Area,



Figure 10. Slaughter slabs with drainage system during operation.



Figure 11. Slaughter slab after cleaning and disinfection.

Kaduna State.

The results showed the 75.00% of the abattoir workers were between the ages of 25-35 years, while 25.00% are between 18-25 years of age ($P < 0.05$) (Table 1). This indicates that workers involved in abattoir operations are of matured ages. The findings revealed that 60.00% of the workers were males while only 35.00% were females. Also, only 30.00% of the workers had tertiary education,

while 65.00% and 5.00% had secondary and primary education, respectively. Though majority of the workers (60.00%) are working in the abattoir for more than 6 years, only 40.00% of them were well trained on abattoir operations and sanitation (Table 1). This survey found that the educational qualification of the workers were significantly associated with level of training about slaughterhouse operations. It found that age group of the

workers correlated with the period of work in the abattoir. This was to be expected due to the nature of work in abattoir. In Nigeria, it is assumed that workers of an abattoir are usually not very well educated and mostly are males. This was evident in the findings of this study which showed that only 30.00% of the workers of the abattoir had education while 65.00% of the workers were males. These findings agreed with works reported by Olowoporoku (2016) and Aburi et al. (2012) who observed that greater percentage of workers in abattoir were between 25-35 years and not well educated in Osogbo and Juba town-South Sudan slaughter houses. should be located close to the livestock market to avoid long distance travelling and transportation of animals, and away from residential areas. It should be properly fenced round to keep out predators and scavenging animals. Provision should also be made for offices, laboratories, and toilets for staff of the abattoir. Zangon Shanu abattoir is not located close to a livestock market, it is surrounded by residential areas, it is not fenced, has no laboratories, and toilets for staff of the abattoir (Table 2). Several studied on abattoir infrastructure and meat handling practices of butchers revealed that most of the abattoir and slaughter houses were located in residential areas and lacked appropriate operational facilities which caused unnecessary losses to meat as well as invaluable by-products from animal carcasses (Adetunji and Awosanya, 2011; Bafanda et al., 2017). Slaughter halls were available and extensive in abattoir, but none of them were divided into different sections for proper and hygienic meat production. These findings were shown by Adetunji and Awosanya, (2011) who observed that lack of proper hygiene and sanitation in the abattoir, lack of sterilization points, continuous use of a single knife, contact with dirty or contaminated surfaces and lack of separation between clean and dirty processes yields unhygienic meat. Ventilation and illumination were sufficient as the slaughter halls at with hygienic procedure satisfactory.

An abattoir should have adequate water supply and electricity. Zangon Shanu abattoir has no electricity supply, but has amply water supply from a standard overhead and hand pump bore holes (Figure 1). The presence of water in the abattoir is of paramount importance from public health perspectives. If sufficient water of drinking quality is available, it will be possible to plan processing and cleaning procedures (washing carcass, equipments, facilities and personnel's) in a way which assures hygienic products. Working routines should be planned to economize the consumption of water because of waste water disposal. This minimizes pollution and ensures hygienic standard during operations. Electricity is required in the abattoir for use in dressing line of carcass dressing, refrigeration and lightening of slaughter hall for adequate visibility during operational activities and cleaning procedures (Akinro et al., 2009; Lawan et al., 2013). Energy supplies will be

necessary if the abattoir is more or less automatic. Energy supplies will also be necessary for automatic cleaning and could be provided through windmills, biogas production, fuel and electricity and water could also be heated by solar energy. If water and energy supplies are sufficient it will be the responsibility of the management of the abattoir to see that these supplies are used efficiently and that sufficient water and energy are used for hygienic purposes. This study differ with that of Akpabio et al. (2015) who assessed the physical conditions and functional status of infrastructure in Aba Abattoir, Abia State, Nigeria and showed that the design of the abattoir was not good enough to pass for a standard abattoir and that there was no functional pipe borne water. Therefore, the butcher's sourced water from nearby streams which gave room for contamination and cross contamination of the carcass.

The observational study indicated the some of the facilities were present, complied to standard abattoir requirement, but non-functional. They were therefore; regarded as either poor or satisfactory (Table 3). The availability and functional status of most facilities observed in this study did not support the standard operating procedures and good hygienic practices in the abattoirs and this situation may pose danger to the public health (Adeyemo, 2002; Lawan et al., 2013). Considering the fact that lairage plays an important role in the abattoir, where resting of animals take place and ante-mortem inspection undertaken prior to slaughter, the results showed that the lairage is present but non-functional (Figure 2). This present result is similar to many others in Nigeria and elsewhere. For example that of Lawan et al. (2013) who evaluated the physical facilities and processing operations of major abattoirs of North-western state of Nigeria and showed that the basic components of the abattoirs were dilapidated and in a deplorable state and attributed it to failure of enforcement on the use of standard facilities in carrying out abattoir operations and general maintenance. And also Zailani et al. (2015) who mentioned in a similar research carried out in selected abattoirs in Bauchi state that the microbial quality of the meat contact surfaces examined were found to be very high and the examined surfaces were heavily contaminated, and that the meat inspection services were virtually absent in all the visited abattoirs as such there was no any documented record of diseases encountered at ante mortem examination or post mortem inspection in the abattoirs.

Sanitary practices in the abattoir were observed to be satisfactory despite the absence of sanitary section in the abattoir. The sanitary practices were done manual with the aid of brooms, water, disinfectants and wheelbarrow (Figure 2). Sanitary facilities must also include an adequate number of toilets and arrangements for hand-washing and bathing, several water points, sterilizers for hand tools, hoses and cleaning equipment. Such facilities must be clean and well-kept at all times and the toilets

should possess hand wash basins along with soap, disinfectants, antiseptics, nailbrushes and clean towels readily available.

This trend of solid waste disposal observed in the present study was also reported by Olowoporoku (2016) in slaughterhouses in Osogbo, Nigeria and Adonu et al. (2017) in slaughterhouse in the Ga West Municipality, Ghana. These methods could be responsible for the decrease in odour, infestation of flies and disease vectors around the abattoir. The practices of keeping solid waste within abattoir for more than a day increases the chances of contamination of meat meant for human consumption.

The practices of waste disposal evident in the present study is satisfactory when compare to others. For example, Olowoporoku (2016) examined environmental sanitation practices in slaughterhouses in Osogbo, Nigeria, and revealed that dumping of waste in premises of the slaughterhouses was the commonest method of the disposal of solid animal waste, while liquid waste, effluents and wastewater were indiscriminately discharged into nearby streams and drainage. Disinfection of the premises was also adequately conducted. After every slaughtering session, the floor and other surfaces that have contact with the animal were cleaned with water and disinfected (Figures 4 and 11). The operation on the slaughter slabs are done with slight hygienic measures which make them to limit cross contamination with little risky food pathogens such as *Salmonella* and *Escherichia coli* O157:H7 as meat from all slabs are not been wash. Study by Abdalla et al. (2009) observed that microbiological contamination of carcasses occurs mainly during processing and manipulation, such as skinning, evisceration, storage and distribution at slaughterhouses and retail establishments.

CONCLUSION AND RECOMMENDATIONS

It can be concluded from the study that some of the facilities and infrastructures are present but not functioning. They were below the requirements and therefore regarded as poor or satisfactory. The most acceptable observations at the facility were the ventilation and the illumination at the abattoir coupled with the availability of potable water supply from the overhead tank and the hand pump boreholes. The daily sanitary activities were satisfactory, but sanitary facilities like toilets, dustbins, water points and sterilizers were absent. The study recommends renovation of some facilities, provision of sanitary sections with well equipped facilities like bins and dumpsites for proper disposal of wastes.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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REFERENCES

- Abdalla MA, Siham E, Suliman YH (2009). Microbial contamination of sheep carcasses at El Kadero slaughterhouse-Khartoum State. Sudan Journal of Veterinary Science and Animal Husbandary 48:1-2.
- Aburi PAS (2012). Assessment of Hygiene practices used by Small Butchers and Slaughter Slabs in beef value chain in Juba town-South Sudan. Wageningen: Wageningen University and Research.
- Adetunji VO, Awosanya AE (2011). Assessment of microbial loads on cattle processing facilities at the demonstration abattoir in Ibadan metropolis Nigeria. Research Opinions in Animal and Veterinary Sciences 1(7):406-409.
- Adeyemo KO (2002). Unhygienic operation of a city abattoir in South-western Nigeria: environmental implication. African Journal of Environmental Assessment and Management 4(1):23-28.
- Adonu RE, Dzokoto L, Salifu SI, Moon AH (2011). Sanitary and hygiene conditions of slaughterhouses and its effect on the health of residents (A case study of Amasaman slaughterhouse in the Ga West Municipality, Ghana. Food Science and Quality Management 5(3):1-57.
- Akinro AO, Ologunagba IB, Yahaya O (2009). Environmental implication of unhygienic operation of a city abattoir in Akure, Western Nigeria. Journal of Engineering and Applied Sciences 4(9):61-63.
- Akpabio U, Kalu E, Babalola SA (2015). Assessment of facilities and slaughter practices in Aba abattoir, Abia State, Nigeria. Journal of Veterinary Advances 5(6):957-961.
- Alhaji NB, Baiwa M (2015). Factors affecting workers' delivery of good hygienic and sanitary operations in slaughterhouses in north-central Nigeria. Sokoto Journal of Veterinary Sciences 13(1):29-37.
- Bafanda RA, Khandi SA, Choudhary F (2017). A Study on the Evaluation of Physical Facilities (Infrastructures) and Processing Operational Units of Major Slaughterhouses and Meat Retail Shops in Jammu Districts of Jammu and Kashmir. Asian Journal of Agricultural Extension, Economics and Sociology 18(2):1-13.
- Bello YO, Oyedemi DTA (2009). The Impact of abattoir activities and management in residential neighborhoods: A Case study of Ogbomoso, Nigeria. Journal of Social Sciences 19(2):121-127.
- Biu AA, Ahmed MI, Mshelia SS (2006). Economic assessment of losses due to parasitic diseases common the Maiduguri abattoir, Nigeria. African Scientist 7:143-145.
- Dandago MA, Farouk SU, Igwe EC (2009). Evaluation of slaughter practices in Kano abattoir. Techno Science Africana Journal 3(1):28-31.
- Douglas KE, Ovua A, Orji C, Sapira B (2013). Health implications of sanitation in a public abattoir in Port Harcourt, Nigeria. The Nigerian Health Journal 13 (2):30-36.
- Ezeohaa SL, Ugwuishiwo BO (2011). Status of abattoir wastes research in Nigeria. Nigerian Journal of Technology 30(2):143-148.
- Komba EVG, Komba EV, Mkupasi EM, Mbyuzi AO, Mshamu S, Luwumba D, Busagwe Z, Mzula A (2012). Sanitary practices and occurrence of zoonotic conditions in cattle at slaughter in Morogoro Municipality, Tanzania: implications for public health. Tanzania Journal of Health Research 14(2):45-62.
- Lawan MK, Bello M, Kwaga JKP, Raji MA (2013). Evaluation of physical facilities and processing operations of abattoirs in North-western states of Nigerian. Sokoto Journal of Veterinary Sciences 11(1):56-61.
- Nafada WD, Ajayi IE, Shawulu JC, Kawe M S, Omeiza GK, Sani NA, Tenuche OZ, Dantong DD, Tags SZ (2012). Bacteriological quality of abattoir effluents discharged into water bodies in Ahuja, Nigeria. ISRN Veterinary Science 9:15-19.
- Nwanta JA, Onunkwo JI, Ezenduka V E, Phil-Eze PO, Egege SC (2008). Abattoir operations and waste management in Nigeria: A review of challenges and prospects. Sokoto Journal of Veterinary Sciences 7(2):61-67.
- Olowoporoku OA (2016). Assessing environmental sanitation practices in slaughterhouses in Osogbo, Nigeria: Taking the good with the bad.

- MAYFEB Journal of Environmental Science 1:44-54.
- Richard OG, Okolocha EC, Odinya AV, Paul MP, Audu DF, Dzikwi AA (2015). Public health risk of abattoir operation in Zango Abattoir Zaria, Kaduna State Nigeria. *Annual Research and Review in Biology* 5(2):139-146.
- Tassew H, Abdissa A, Beyene G, Gebre-selassie S. (2010). Microbial flora and food borne pathogens on minced meat and their susceptibility to antimicrobial agents. *Ethiopian Journal of Health Sciences* 20:137-143.
- Zailani SA, Bello M, Raji MA, Kabir J, Yahuza SM (2015). Microbial evaluation of meat contact surfaces in red meat abattoirs of Bauchi State, North-Eastern Nigeria. *Open Journal of Medical Microbiology (OJMM)* 6:3-8.