

Abattoir operations and waste Management

Options: A review

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Abstract— Abattoir wastes which are wastes generated during the various operations that are aimed at processing for consumption categorized as solid, liquid or gaseous have the potential to pollute the environment. They are stages in the abattoir operations and the adequacy of the operations is key to healthy products and environment. This study reviews the handling stages in an abattoir from animal arrival and temporary storage, stunning/Immobilising, slaughtering/bleeding, skinning, evisceration and Splitting to the roasting and washing operations. The waste handling point was noted to be categorized as solid which consist mainly of bone and compostable material, Liquid waste which include wash water, intestinal fluid and blood and the gaseous waste that includes emission due to the use of fuel for roasting of skin which is used in meals in parts of West Africa. Research on the alternative use of waste from the various abattoir wastes has been suggested in the study. The application of liquid waste and the part of solid waste for biogas production and purification (using charred bone) and deploying of the biogas as fuel for the roasting operation.

Keywords— abattoir, wastewater, waste, blood, bone, biogas.

I. INTRODUCTION

The meat industry has experienced crises in the recent past, including the mad cow disease and continental disputes over protein supply from countries to countries, also the bird flu and another influenza that occurred in the recent past were important to make conscious effort to monitor various stages of the meat industry adopting acceptable and amenable global practice. These stages include the slaughter and meat processing stages. The Abattoir is a place where animals are slaughtered for the purpose of production of meat/protein which are supplied to the public. As much as the activity and its individual operations are to provide the needed source of protein, the way and manner it is handled and its by-products or wastes sadly could constitute hazard when the proper steps are not taken into cognizance (Weobong and Adinyira, 2011; Adelegan, 2002; Adeyome et al., 2009). The Abattoir facility has various waste and waste generation points and handling options. But in many countries, the abattoirs are not just crude but the wastes generated are not treated before disposal. Also, the regulatory bodies are never up to their duties to monitor the processing activities and the disposal of the waste (Adzitey, et al., 2010; Mohammed and Musa, 2012).

Abattoir wastes consist of several pollutants such as faeces, blood, bone, hone, fat, animal trimmings, paunch content and urine from operations, stunning or bleeding, carcass processing and by-product processing (Aniebo, et al., 2009; Nwachukwu, et al., 2011). These abattoir wastes can be classified as solid, liquid and gas. Abattoir waste can be detrimental to public health, animal health, and the economy of the country if they are not properly and effectively managed and controlled (Aina and Adedipe, 1991). Abattoirs often have difficulties in disposing, treating and processing of these wastes in an environmentally acceptable fashion. Due to these reasons, there is high risk of environmental pollutions like underground water pollution, air pollution, nuisance, odour, soil pollution and public health risks through the transmission of zoonotic diseases to humans (Osibanjo and Adie, 2007).

Nigeria had a period of boom in agricultural activities with a great export program. Animal rearing and cattle ranching projects were recorded in many states. This increased abattoir activities, therefore, should be complemented with adequate environmental programs to avoid poisoning and damage to the environment (Ezeoha and Ugwuishiwu, 2011).

Good manufacturing and hygienic practices; solid, liquid, and gaseous waste management practices are highly necessary to minimize the harmful effects of abattoir wastes. Safe disposal, treatment, and processing methods like burying, composting, rendering, incineration, anaerobic digestion, and blood processing are also highly important to guarantee economic benefits from abattoir wastes/by-products rather than controlling public health risks and environmental pollution (Bellow and Oyedemi, 2009).

Most abattoirs in Nigeria do not have proper animal handling and waste treatment facilities. In all the stages that a standard abattoir should have from Arrival to packing, all reports and visits showed crude processes and operations. Animals go through pain when they are being slaughtered, the handling of the meat is too poor and finally, the waste generated gets inadequate treatment (Adewumi et al., 2016; Bandaw and Herago, 2019)

This review on the operations of abattoir activities and the suggested handling of the waste, therefore, will include the following

- Overview of standard abattoir operations
- Abattoir waste content and handling.
- The handling of abattoir waste operations
- An alternative application of abattoir wastes

II. STAGES IN THE ANIMAL SLAUGHTER OPERATION

- 1) Animal arrival and temporary habitat
- 2) Stunning/Immobilising of Animal
- 3) Slaughtering/bleeding
- 4) Skinning
- 5) Evisceration and Splitting
- 6) Roasting and washing

1) Animal arrival and temporary storage

The animal arrival and temporary habitat area (see Fig 1) is the place where animals are kept when they are brought to the abattoir. Here the selection is carried out for the animal to be transferred to the slaughtering bay. The waste generated here includes dungs and feed that drops on the floor. The dungs are periodically evacuated to a dump area. Animals are also rested here to calm them from the transfer stress experienced during transportation. From the temporary habitat area, the animal for slaughter is selected and taken to stunning or immobilization point. This waste generated in this area is biologically degradable solids that can be composited into manure. This organic waste is usually disposed of by burying. It's worthy of note that the improper handling of this waste will result in potential

environmental risk (Alonge, 2005; Bandaw and Herago, 2017).



Fig.1: Animal in the arrival area.

2) Stunning/Immobilising of Animal

The stunning of animals at the slaughter is to render the animal unconscious before bleeding and slaughtering. Stunning can be carried out using electric shock, mechanical or gas stunning to keep the animal unconscious until bleeding. Immobilization may not provide total unconsciousness but provide restraint. In almost all the facilities in Nigeria, the strain is used than stunning or immobilization. There is no waste produced at the stunning stage in the slaughtering process.

3) Slaughtering/bleeding

A part of the slaughtering process is the bleeding which involves letting out of the blood through the blood vessels when the blood vessel/artery at the neck is severed. The flow of blood out of the animal result in death. Complete or almost complete bleeding is recommended to avoid residual blood in the arteries that can result in contamination as bacteria growth occurs with the blood as a medium. The waste generated at the bleeding section of the abattoir is blood which needs proper handling as it initiates microbial growth within a short while. Blood is a medium for a blood culture test and when blood is not handled and disposed of properly this will lead to contamination and pollution at the abattoir.

4) Skinning

Skinning is the act of skin removal. The skinning of the animal is carried out after bleeding. Mechanical or manual skinning is used in the abattoir. The process is done with animals, mainly as a means to prepare the muscle tissues beneath for consumption or for use of the fur or tanning of the skin. Typically, large animals are open skinned and smaller animals are case skinned.



Fig.2: Animal Skinning

5) Evisceration and Splitting

After the skinning operation, the carcasses are washed and positioned for evisceration and splitting. Opening and cutting are done using knife, axe and saw. The cutting starts with the aitch bone and then opening of the anus and the bowel and reproductive tract, the gut stomach is taken off. The contents are removed in these operations and abdomen are removed and washed. Splitting is done on the carcass for the removal of the bones and then chopping operation is used to reduce size.

The meat is now transferred to tables for packaging, evacuation to the market or for retail.

The waste generated includes solid (bone, undigested food, dung, etc) liquid (blood, wash water, semen, etc).

6) Roasting and washing.

In a typical Nigerian abattoir, the skin of the animal (for cow) is cut to sizes (see Fig 2) for roasting which fire from used car tyres, firewood or other fuels are used to roast the skin (see Fig 3)



Fig.3: Animal skin roasting operation

After the roasting, the roasted skin is taken to the washing pool, see fig 4.



Fig.4.1: Roasted animal skin wash operation



Fig.4.2: Roasted and washed animal skin

III. WASTE GENERATION AND HANDLING

The waste from abattoir ranges from fluid intestinal to solid bones and gases from the roasting of the skin.

Handling

The handling of wastes from Abattoir including management are based on these categories

Liquid Abattoir waste handling

The liquid waste in abattoirs in Rivers State, Nigeria are poorly managed. Researches recorded blood, wash water, intestinal fluid, which involves Chemical Oxygen demand (COD) and Biological Oxygen demand (BOD) of densities ranging from 180 to 218,000mg/l and 120 to 160,500mg/l respectively (Ezeoha&Ugwuishiwi, 2011; Oruonye, 2015; Bandaw and Herago, 2017).

The blood and the wash water are discharged into the public drain without treatment. Scavengers visit abattoir facilities some times to collect the blood, boil and dry it into blood meals for animal feed. At present, there is no concrete arrangement for the use or management of liquid waste from 90% of the abattoir in Rivers State, Nigeria.

Solid Abattoir waste handling

The solid waste is mainly; bones, horns, animal dung/faeces/droppings, Paunch or Intestinal content. These

are mainly heaped (see fig 5) in the abattoir for further processing. In the facility, they constitute a nuisance due to the odour and the flies and rodents it attracts (Ezeoha&Ugwuishiwi, 2011; Bello &Oyedemi, 2009).

The bone is crushed after burning to make animal feed mill. The faecal and intestinal content is composted into soil conditioning or plant manure (Oruonye, 2015).

Gaseous emissions handling.

The major gas emission point in the abattoir is the skin roasting operation (see figure 3). At this stage firewood, used car tyre or used plastics are deployed as fuel. This results in pollution of the environment and contamination of the skin are will a delicacy in parts of West Africa. Polychlorinated bisphenols (PCBs) are chief culprits in the contamination of food and meat during preparation or processing with some petroleum and other carbon-based fuel.

IV. QUANTITY OF WASTE AND SUGGESTED USAGE

A number of applications can be found for the waste generated in abattoir facilities as the quantities of these wastes justify applicable and appreciable quantity (Table 1).

Biogas from Abattoir water

The quantity of solid waste and fluids obtained from abattoir can be rightly applied for the production of biogas. Further research can be done to produce material balance on the exact quantity of waste and economic viability as a feed for a biogas plant(Omole and Ogiye, 2013).

The carbon-rich waste and its possibility of appropriate Carbon/Nitrogen (C/N value) can be harness as complements from other agro wastes such as sawdust may be considered.

Biomethane filter

The bone that is burnt and crushed can be a good source of filter for the purification of the biogas to obtain rich methane biogas for use.

These could produce biogas of appropriate calorific value for roasting of the skin which can substitute the car tyre and firewood which has environmental consequences. Also, the biogas will have little or no health effect compared with the fuel currently used for roasting of the skin. The quantity of waste material from various wastes is tabulated in table 1.

The proper and planned application of the waste from the abattoir will help in the design of proper deployment of the streams of waste to appropriate ways that will make its handling viable and create a conscious effort in its usage to

reduce the pressure that can lead to misuse(Fearon et al., 2014; Rabah, 2010).



Fig.1. A heap of Intestinal content and dung

Table 1: Abattoir waste and sources

S/N	Animal Type	Qty of Animal	Waste source	Quantity waste	Phase	County/Region	Reference	
1	Cow	Per Cow	Blood	12.6 (kg)	liquid	Nigeria	Aniebo et al, 2009 &Oruonye 2015	
2	Goat	Per Goat	Blood	0.72(kg)	liquid	Nigeria		
3	Cow	Per Cow	Intestinal	8.0(kg)	Solid	Nigeria		
4	Goat	Per Goat	Intestinal	1.25(Kg)	Solid	Nigeria		
5	Cow	Per Cow	Waste tissues	6.4(Kg)	Solid	Nigeria		
6	Goat	Per Goat	Waste tissues	0.80(Kg)	Solid	Nigeria		
7	Cow	Per Cow	Bone	11.8(kg)	Solid	Nigeria		
8	Goat	Per Goat	Bone	2.06(kg)	Solid	Nigeria		
9	55 Cattle,	Lot	Blood	0.7 ton	liquid	Tamale, Ghana		Fearon et al, 2014
10			Gut	0.5 ton	Mix			
11	50 Sheep		Waste tissues	0.4 ton	Solid			
12	20Goat		Bone	0.7 ton	Solid			

V. CONCLUSION AND RECOMMENDATION

The study reviewed the abattoir operations and waste management options with a view of looking at the operations that go on in abattoirs. The various waste and how they are handled and alternative or suggested ways of adequate adoption or deployment of the waste.

The abattoir operation starts from the arrival and temporary storage point where the animals are kept on arrival to the stunning and immobilizing point where the animal is restrained and incapacitated before slaughtering. The next point is the bleeding and slaughtering where the animal is killed. The hides and skin are removed at the next point in the abattoir operation and then the evisceration and splitting point where the animal is cut into parts and ready for packing and transfer to the market or storage. The other operation is the roasting and washing where the skin is roasted and washed.

The waste generated in the abattoir that finds useful application is classified as liquid, comprising of the blood, wash waste and intestinal fluids which is the most abattoir is discharged without treatment into open drainages of water body, and as solid which includes bones, horns, intestinal content that are majorly used as manure. The bone is burned and crushed for bone meal.

Adequate and planned application is suggested for the use of abattoir waste as feed-in biodigesters and the use of the bone for cleaning of the produced gas into purer biomethane that can serve as an environmentally friendly fuel for roasting of skin.

The outcome of this review is the suggestion of the production of biogas using abattoir wastes with the animal bone serving as a filter for purer biogas. The recommendation, therefore, is that with an appropriate and well-designed biogas plant, adopting this method of

production and treatment will guarantee purified biomethane gas.

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