



of the country (Lagos State), the government in partnership with Skye Bank introduced Eko meat van (EMV) used in the transportation of meat. Thus approach is recommendable and should be encourage to be adopted across the country.

Conclusion and Recommendations

It is concluded that the management practices, processing and transportation of meat in Kano metropolis abattoirs in particular and all slaughter slabs across the country (Nigeria) in general, need greater attention in order to be improved and modernized to reach standard. Public enlightenment through media should be encouraged. Regular cleaning of vehicles is very important to avoid contamination and meat spoilage. Thus necessitate Government/NGO's interventions to add manpower and provide facilities like modern refrigerating van that can protect and improve meat quality and its safety to consumers.

References

- Ademola, A. I. (2010) Incidence of fetal wastage in cattle slaughtered at the Oko-Oba abattoir and lairage, Agege, Lagos, Nigeria. *Vet. Research* 3(3):54-57
- Adeyemo, O.K. (2002) Unhygienic operations of a city abattoir in South Western Nigeria: *Environmental Implication*, 4(1):23-27
- Dandago, M.A., Farouk, S. U. and Igwe, E.C. (2009) Evaluation of slaughter practices in kano abattoir *Techno Science Africana Journal*, Volume 3 Number 1
- Gude, M. I. (2014) Camel (*Camelus dromedarius*) Slaughtering, Meat Processing and Handling at Kano Main Abattoir, Kano State, Nigeria. In: Abdullah, A. R., Tayo, G.O., Okunbanjo, A. O. and Akinsoyinu, O. A. Proc. 39th Conf., Nig. Soc. for Anim. Prod. 16 - 19 March, 2014. Babcock Univ. Ilishan-Remo, Ogun State, Nigeria. Pp. 498 – 501
- Igwe, E. C. and Yakubu, B. (2000) Animal Slaughter Characteristics: Implications for the future of Beef production and Peoples' nutrition. Proc. 5th Ann. Conf. Animal Science Assoc. of Nigeria. Port Harcourt, Nigeria
- Igwe, E. C. (2005) Adamawa State Meat Industry. In: Agriculture in Adamawa State. Edited by Igwe, E. C., S. I. Mshelia, S. I. & Jada, M. Y. Paraclete Pub. Yola. ISSN: 978-8055-26-5
- Ikeme, A. I. (1990) Meat Science and Technology: A Comprehensive approach. African FEP Publishers, Onitsha
- Kebede, N. (2010) A retrospective survey of bovine hydatidosis in three abattoirs of Amhara National Regional State, North-western Ethiopia. *Tropical Animal Health and Production*, 42:323–325
- Lamidi, A. A., Ologbose, F.I., Evien, E. E and Akhigbe, J. (2017) Abattoir Management Practices, Meat Processing and Handling in Port Harcourt Metropolis, Rivers State, Nigeria. Proceedings of 6th ASAN-NIAS Joint Annual Meeting Abuja. Pp 223-227
- Lawan, M.K., Bello, M., Kwaga, J.K.P. and Raji, M.A. (2013) Evaluation of physical facilities and processing operations of major abattoirs in North-western states of Nigeria. *Sokoto Journal of Veterinary Sciences*, 11(1):56-61



HYGIENIC FACTORS THAT INFLUENCE MEAT QUALITY; A REVIEW

*ADEBAYO, O.A., AROGBODO, J.O and AWONIYI, T.A.M.

Department of Animal Production and Health, School of Agriculture and Agricultural Technology, The
Federal University of Technology, Akure

*Correspondence: jomilojubabe@gmail.com Tel: +2347037908717

ABSTRACT

Meat as an important source of protein in the diet of man cannot be overlooked. As a livestock product, the safety depends on the health of the animal and the factors affecting its production which include animal shed and environment, feeding and nutrition factors, slaughter house and slaughtering process with the equipment, water supply, etc. This paper discusses these factors from the perspective of hygiene and its safety for human consumption. It was concluded that ensuring on-farm health status of the animals is vital to the quality of their products entering the food chain.

INTRODUCTION

Livestock can be defined as farm animals such as cattle, sheep, goat and chicken that are kept on a farm as assets to a farmer with the aim of making profit or for domestic uses (Johannesen and Skonhøft, 2011). An animal product is any material derived from the body of an animal. Examples are flesh, blood, milk, eggs etc (Unklesbay, 1992). They are sources of animal protein for human nutrition. In general, hygiene according to the World Health Organization (WHO), "refers to conditions and practices that help to maintain health and prevent the spread of diseases (Buncic, 2006). Farm hygiene is the way of protecting the farm environment by preventing the introduction and spread of microbes and diseases which may adversely affect livestock. Optimising the health of animals increases productivity, and majorly protects human health by ensuring that food of animal origin are safe for consumption. Poor hygiene affects not only the farmer's productivity in terms of quantity and quality of product but it also negatively impacts the status of the country. Quality is expressed of as a degree of excellence; in terms of a product (farm product in this instance), it is referred to as a specification or set of specifications which are to be met, within given tolerance or limits, and which will make the product to be acceptable to the buyer at an economic cost to the producer (David, 2005). This write up thus reviews the hygienic factors that influence the quality of meat.

Keywords: animal products, meat, hygiene, quality

Meat and its Hygiene

Meat is defined as all parts of warm-blooded animals, in fresh or processed form, which are suitable for human consumption in the Regulation (EC) 853/2004. Usually, the muscles of healthy animals are essentially sterile at the point of slaughter (Krämer, 2002). However, during slaughtering and processing the meat surface is contaminated with a variety of microorganisms (Krämer, 2002; Olsson *et al.*, 2003; Kleer, 2007). Meat hygiene programmes are primarily instituted to ensure that meat and meat products are "safe and wholesome". When meat is considered as spoiled, it is no longer acceptable for human consumption which is mainly attributed to sensory changes e.g. in colour, odour, flavour, aroma or texture (Mead, 2004; Singh and Anderson, 2004). Meat is among the most highly nutritious foods and a good source of protein, fat and minerals. It is also a highly perishable product because cooked and especially raw meat is a good substrate for the growth and multiplication of harmful microorganisms. As a result, several diseases may be transmitted to humans through the consumption of infected meat or meat products.

Hygienic factors that influence the quality of meat

Building/ Facility (Housing)

Ideally the slaughterhouse should be located away from residential areas to prevent possible inconvenience to dwelling-places either by way of pollution from slaughter wastes or by way of nuisance from noise. There must be free access for animals to the site by road and the slaughterhouse should be situated in areas where flooding is unlikely to happen. The number of animals to be slaughtered should take into account the



size of slaughter facility and the number of animals to be slaughtered is of great importance to avoid sanitary problems due to overcrowding. Materials that are absorbent and difficult to keep clean must not be used. Examples of unacceptable materials include wood, plasterboard and porous acoustic-type boards. Walls should be provided with suitable sanitary-type bumpers or sloped curbs to protect them from damage by hand trucks or lifters (Critical Design, Operational and Equipment Guidelines for Licensed Abattoirs, 2012).

Lairage is a place where livestock are kept temporarily (Critical Design, Operational and Equipment Guidelines for Licensed Abattoirs, 2012). This is a specific area inside the premises of a slaughter house where the animals are conveyed for rest. Rest is an important factor because when animals are stressed, carcasses of lower quality result from slaughter. There should be sufficient space for the animals and a good supply of potable water for drinking purposes.

Feeding and nutrition factors

Traditionally, feed is preferably withheld from ruminants immediately before and during periods of transporting to, and lairaging at, abattoir. However, water is offered to animals throughout the pre-slaughter period. The reasons for feed withdrawal include difficulties which overfilled guts would cause during dressing (evisceration) of slaughtered animals, as well as economic aspects (Gracey, *et al.*, 1999). Generally, the two main foodborne pathogens associated with beef, *Salmonella* and verocytotoxin *E. coli*, do not proliferate in the rumen environment, except under conditions of extended starvation, which leads to a reduction of the volatile fatty acids concentration (Rasmussen, *et al.*, 1993). The higher occurrence or levels of pathogens in rumen can increase their occurrence or levels in faeces, which increases microbial beef safety risks associated with those animals. On the other hand, it could be expected that some feeds (e.g. silage) increasing physical spread ability of the faecal excreta in the environment also could enhance spread of microbial hazards both on-farm and during transport-lairaging.

Animal cleanliness

Microorganisms including foodborne pathogens present in cattle faeces are frequently transferred, through direct or indirect routes to the hide, which is now recognised as the major source of microbial contamination with these organisms. Total viable counts of bacteria, occurrences of inoculated marker *E. coli* (Collis, *et al.*, 2004), and prevalence of *E. coli* O157 (Elder, *et al.*, 2000) on beef carcasses, all can be significantly affected by, and even correlated with those present on respective hides. Also, it has been demonstrated that degree of visual coat soiling has a significant effect on the contamination level of the finished carcass (Byrne, *et al.*, 2000; Hadley, *et al.*, 1997).

Hygienic status of cattle hides significantly depends on maintenance of clean stables, and is also influenced by type of their diet. It has been widely accepted that animal cleanliness is crucial to avoid the introduction of potentially pathogenic microorganisms in the beef processing line, so it is necessary to ensure that only clean cows are presented for slaughter (Bolton, *et al.*, 1998).

Water supply

Water is a vehicle for the transmission of several agents of disease and continues to cause significant outbreaks of disease in developed and developing countries (Kirby *et al.*, 2003), several instances were purported to have been affiliated with poor quality water. Since slaughtering is a process which generates a lot of wastes, to cater for the good running of the processes and minimize contamination, there should be a good supply of water of drinking quality to allow processing and cleaning procedures which will ensure hygienic quality products. Working routines should be planned in such a way as to economically use the consumption of water because of waste water disposal (Kirby *et al.*, 2003). It is also important to ensure that water storage vessels are properly covered, and cleaned regularly to maintain the water in a potable state.

Sanitation in the slaughter house

Sanitation may be defined as the process involved in the ensuring of good health by means of preventing human contact with the hazards of wastes. Such hazards can be physical, microbiological, biological or chemical agents of disease (Hui *et al.*, 2003). The major goal for the food processing industries is to provide safe, wholesome and acceptable food to the consumer and control of microorganisms is essential to meet this objective (Baggen *et al.*, 2003). In line with this, a slaughterhouse should be designed to ensure the



flow of operations from the live animal holding area through to discharge areas. Meat products should, therefore, proceed progressively through cleaner areas of the operation, without backtracking to areas where the product was previously handled. Edible and inedible areas must be physically and operationally separate. Sources of meat contamination during slaughter may be classified as those associated with the animal, processing practices, abattoir facilities and employees.

Equipment

Equipment for undergoing slaughtering process, have to follow certain norms and regulations, it has been reported that such equipment have to be of non-corrosive materials, for example stainless steel. Structures like tables, hooks and machines should be positioned such that, they will be easy to relocate to facilitate cleaning and disinfection.

Slaughtering Processing

The hallmark for hygiene principle in processing is that the procedures considered as clean and unclean should be efficiently separated. This requires a well-structured plant layout, where the purpose of any structure should be the protection of the end product against accidental contamination (CAC, 1997).

Personnel

The personal hygiene of the workers is a primordial factor in slaughtering operations. The reason is simply that, contamination of food and disease transmission, depend upon the human factor as well as on the tools and mode of operation. Transfer of microorganisms by personnel particularly from hands is of vital importance (Bloomfield, 2003). During handling, bacteria are transferred from contaminated hands of workers to the food and subsequently to other surfaces. It is important to limit access into the premises during the time of slaughter. All personnel that are allowed access should also be dressed in the appropriate personal protective clothing, e.g. clean trousers and wearing appropriate waterproof aprons. Boots should be worn with the trousers neatly folded inside. The hallmark is that the workers must strictly abide to a formal code of hygiene.

Conclusion

Good hygienic practices (GHP) including provision of optimal animal health status in form of housing, feeding, water supply etc enhance the animals' resistance to infections, productivity and reduces on-farm spread of food safety hazards, such as poor growth, diseases and unwholesome meat and meat products.

References

- Baggen-Ravn, D. Hjelm, M. Christiansen, N. J. Johansen, C. and Gram, L. (2003). The microbial ecology of processing equipment in different fish industries-analysis of the micro flora during processing and following cleaning and disinfection. *International Journal of Food Microbiology*. 87: 239-250.
- Bloomfield, S. F. (2003). Home Hygiene: a risk approach. *International Journal of Hygiene and Environmental Health*. 206: 1-8.
- Bolton, D.J, Byrne, C and Sheridan, J.J. (1998). The survival characteristics of *Escherichia coli* O157:H7 and transfer from the contaminated hide to the carcass during slaughter. 44th International Congress Meat Science and Technology, Barcelona, Spain.
- Buncic, S. (2006). Integrated Food Safety and Veterinary Public Health. Wallingford, Oxfordshire, UK, CABI Publishers. pp 15.
- Byrne, C.M, Bolton, D.J, Sheridan, J. J, McDowell, D.A and Blair, I.S, (2000). The effects of preslaughter washing on the reduction of *Escherichia coli* O157:H7 transfer from cattle hides to carcasses during slaughter. *Lett Appl Microbiol* 30 (2), 142-145.
- CAC (Codex Alimentarius) 1997. Hazard Analysis and Critical Control Point (HACCP) System and Guidelines for its Application. Codex Alimentarius Commission CAC/RCP 1-1969, Rev. 3, Rome.
- Collis, V.J, Reid, C.A, Hutchison, M.L, Davies, M.H, Wheeler, K.P, Small, A and Buncic S, (2004). Spread of marker bacteria from the hides of cattle in a simulated livestock market and at an abattoir. *Journal of Food Protection* 67 (11), 2397-2402.
- Critical Design, Operational and Equipment Guidelines for Licensed Abattoirs (2012). Abattoirs Code of Good Practice. Food Protection BC Centre for Disease Control, Pp2-23
- David, O. A. (2005). Meat and Milk Hygiene. Farmco Press, University of Ibadan, Nigeria. Pp 100-102.



- Elder, R.O, Keen, J.E, Siragusa, G.R, Barkocy-Gallagher, G.A, Koohmaraie, M and Laegreid W.W, (2000). Correlation of enterohemorrhagic *Escherichia coli* O157 prevalence in feces, hides, and carcasses of beef cattle during processing. *Proc Natl Acad Sci U S A* 97 (7), 2999-3003.
- Gracey, J. F, Collins, D.S and Huey, R.J. (1999). *Meat hygiene*. London, UK, W.B. Saunders Company Ltd, Harcourt Brace and Company.
- Hadley, P.J, Holder, J.S and Hinton, M.H, (1997). Effects of fleece soiling and skinning method on the microbiology of sheep carcasses. *Vet Rec* 140 (22), 570-574.
- Hui, Y.H. Bernard, L.B. Richard, J.G. Nip, W.K. Phillip, S. T. Phil, V. (2003). *Food Plant Sanitation*. Marcel Dekker AG. Hutgasse 4, Postfach 812 CH-4001 Basel Switzerland Pp 4- Pp 5-35
- Johannesen, A. B. and Skonhoft, A. (2011). Livestock as insurance and social status: Evidence from reindeer herding in Norway. *Environmental and Resource Economics*, 48(4): 679-694.
- Krämer, J. (2002). *Lebensmittel-Mikrobiologie*. 4. Auflage, Verlag Eugen Ulmer, Stuttgart, Germany.
- Mead, G. C. (2004). Shelf-life and spoilage of poultry meat. In Mead, G. C. (ed.), *Poultry meat processing and quality*, pages 283–303. Woodhead Publishing Limited and CRC Press, Cambridge, UK and Boca Raton, USA.
- Olsson, C., Ahrne, S., Pettersson, B and Molin, G. (2003). The bacterial flora of fresh and chill-stored pork: analysis by cloning and sequencing of 16S rRNA genes. *International Journal of Food Microbiology*, 83(3):245–252.
- Rasmussen, M.A, Cray, W.C, Casey, T.A and Whipp, S.C, (1993). Rumen contents as a reservoir of enterohemorrhagic *Escherichia coli*. *FEMS Microbiol Lett* 1, 14(1): 79-84.
- Singh, R. P. and Anderson, B. A. (2004). The major types of food spoilage. In Steele, R. (ed.), *Understanding and measuring the shelf life of food*, Woodhead Publishing Limited and CRC Press, Cambridge, UK and Boca Raton, US. pp 3–19
- Unklesbay, N. (1992). *World Food and You*. Routledge, pp.179.