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Environmental and microbial implications of animal waste products: A case study of pork fat and beef fat

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ABSTRACT

Developing countries are known to dispose waste indiscriminately into their environment of which fat is one of them. These fats release awful odor making passersby uncomfortable and also breeds microorganisms. Environmental factors such as rainfall, sunlight and wind aid the migration of these fats to other sites thereby leading to contamination. Total heterotrophic plate count of pork fat ranged from 4.0 x 10^5 cfu/g to 4.2 x 10^5 cfu/g and its total coliform plate count was from 3.8 x 10^5 cfu/g to 4.0 x10^5 cfu/g while the total heterotrophic plate count of beef fat ranged from 3.1 x 10^5 cfu/g to 3.5 x 10^5 cfu/g and its total coliform plate count was from 2.4 x 10^5 cfu/g to 2.8 x10^5 cfu/g. *E.coli* and *Salmonella* sp. were the highest occurring in both fats. Pork fat had more microbial count than beef fat. Fats can be converted to useful products and this will lead to the reduction of waste in the environment. Statistical analysis showed significant difference in mean counts of pork and beef fat samples at $p \leq 0.05$.

KEYWORDS

Pork fat; Beef fat; Microorganisms; Environment; Wastes.

INTRODUCTION

Environmental pollution is an issue that has been a threat to the world for many years and is presently a major problem because of the rapid population growth in developing countries[1]. The burden of increasing waste and its control in urban areas of developing countries is an environmental concern. This situation grew worse as a result of the lack of technology to help reduce the heap of wastes[2]. Another worldwide problem is soil pollution which is as a result of waste discharges freely dumped into the environment. The richest reservoir of microorganisms which is the soil, plays a major role in the ecosystems because the continuity of the environment depends largely on it. If the soil becomes polluted, the ecosystem is tilted and activities such as agriculture is disrupted[3,4]. A major problem of many urban areas in Nigeria is the low sanitary condition which is best described by Sule[5] as indiscriminate waste disposal and the ability to reduce it to the minimum and also the poor usage of laws for this waste disposal problem. These abnormal waste dumping methods have

created many problems such as sanitation and environmental issues, imbalance of groundwater and pollution of soil and water resources[6]. This pollution problem either on air, water or land which was caused by man's day to day lifestyle activities is rapidly growing to a point that it can longer be managed and will be seen as a normal way of life. This issue has a negative effect on human health and well-being.

One of the by-products of animals is fat[7] and it can be edible or in-edible depending on the animal and the animal's part it is gotten from. Cattle is a source of protein and fats[8]. Fat has a basic role in meat quality. Surface fat stops frequent cooling of the underlying muscle tissues, which lowers the tendency of cold-shortening and lowers loss of weight as a result of chilling. The hardness or softness of fat has a direct impact on its processing efficiency and fat also adds to the beneficial properties of meat. Physical properties to look out for in fat are color, hardness and texture. The better the properties of fat, the higher the market value. It is known that 85% of fat tissue consists of triglycerides located in the fat cells; for every triglyceride, three molecular fatty acids are found in it. The other part of the fat tissue consists of moisture which is approximately 12% and the connective tissue which is approximately 3%. It is true that different types of collagen and various levels of cross-linking is key to the structure of fat tissue and these affect the texture, the strength of fat at any temperature and it is dependent on the composition of its fatty acid and also the molecules that constitutes its triglycerides. Palmitic and stearic acids are saturated fatty acids with high melting points of about 65-70°C and this accounts for hard fat, unlike palmitoleic and oleic acids which are unsaturated fatty acids with low melting points of 0-15°C and contribute to softness. The temperature at which fat melts, depends on the amount each fatty acid contributes. In Australia, prolonged grain feeding enhances fat color, leads to a uniform product and a rise in the hardness of fat[9].

Mature Pigs are known to have fat. Feeding habits, the composition of animal feeds, breed diversity, animal age and other factors are major contributors to the quality of pork fat[10]. The quality of Pork may increase or decrease as a result of nutrition, genetics, management, and pork-processing procedures. The lean genotype of Pigs which are fed with diets that are high in unsaturated fat might possess thinner and soft fat at their bellies which is of low quality[11]. This reduction in fat quality is related to their thinner bellies and this might negatively affect the processing, separation of tissue, and stability during storage. A number of factors define the quality of pork such as color, consistency, and keeping quality, and these are affected by the size of the fat deposits located in the pig and the composition of dietary fat. The fatty acid profile of pork fat is a representation of the role played by each source of dietary fat[12-14].

Oleic and palmitic acids are the main fatty acids in beef fat[15]. A number of factors such as breed of Cattle, sex, diet, weight, age, fatness and environmental conditions which include climate and season are known to affect the composition of fat tissue in cattle. Although the factors do not apply to all cattle for example, the cattle known as Brahman is known for a higher unsaturated fat content than a few other breeds. Brahman-cross cattle have softer fat when compared to purebred Hereford and various crossbreeds. Most likely, age plays a major role in the unsaturation of fat, the older an animal becomes, the more unsaturated fat it is likely to have. Cooler climates are known to have Cattles with softer subcutaneous fat. When a healthy cattle grazes green pasture, it takes in and utilizes the yellow pigments in these plants known as carotenoids, beta-carotene which makes up a larger part of carotenoids gives the fat its color. Most fats are known to have cream/ yellow color.

The aim of this research is to identify the impact of fats in the environment and the microbial load of these fats.

RESEARCH METHODS AND MATERIAL

Fat samples were collected from slaughter houses in Umuahia, Abia State, Nigeria. These samples were collected in sterile polythene bags and transported within 45 minutes to the laboratory for microbiological analysis. All laboratory procedures were done aseptically. One gram of each mashed sample was introduced into 9ml of distilled water, the conical flask was carefully shaken and from it, ten-fold serial dilution was done[16]. Pour plate method was used for the isolation of microorganisms on MacConkey agar and Nutrient agar

at 37°C for 24-48 hours. Pure isolates were identified and characterized. The other part of fat which were not bought from slaughter houses were discarded as waste.

RESULTS AND DISCUSSION

A total of ten samples were used for this study. Five out of the ten samples were pork fat while the other five samples were beef fat. Total heterotrophic plate count (THPC) and total coliform plate count (TCPC) of pork and beef fat samples is shown in TABLE 1. These samples had higher counts for total heterotrophic plate counts than total coliform plate count.

TABLE 1: Mean bacterial counts of pork fat and beef fat

Sample	THPC (cfu/g)	TCPC (cfu/g)
beef fat	3.3×10^5	2.6×10^5
Pork fat	4.1×10^5	3.9×10^5

TABLE 1 shows that pork fat has higher bacterial load than beef fat. This could be as a result of the physical appearance of pork fat. Pork fat appeared wet with more oil content than beef fat. A research by Abdelwhab[17] revealed that beef fat had lesser fat content than mutton fat. This slimy nature of pork fat could be the reason behind its higher number of microbial load. Aymerich et al.[18] identified that meat with aw between 0.94-0.99 promoted microbial growth. Also, pork fat might have higher nutrients than beef fats which make microorganisms able to thrive more in it. Lulietto et al.[19] stated that meat has high protein, lipids, minerals and vitamins contents, but low carbohydrate content which allows some organisms to survive. Nychas et al.[20] recorded that the spoilage of meat is as a result of some available substrates such as glucose, lactic acid, nitrogenous compounds and free amino acids present in the meat.

Four bacterial isolates were identified from this study and they are *Pseudomonas aeruginosa*, *E.coli*, *Salmonella* sp. and *Proteus* sp. Odey[16] isolated seven bacterial isolates and they include *Staphylococcus* spp, *Streptococcus* spp, *Escherichia coli*, *Salmonella* spp, *Bacillus* spp, *Pseudomonas* sp. and *Proteus* sp. The microbial counts from nutrient agar from their sample was from 1.4×10^5 cfu/g to 3.5×10^5 cfu/g. Lamb[21] identified the presence of *Samonella* sp. in all fat and oil samples which also included beef tallow and pig lard. Shaffer[22] stated that the common bacterial contaminants in pork are *E. coli*, *Salmonella* sp., *S aureus*, and *Yersinia enterocolitica* and that the intrinsic properties of meat, such as pH and moisture promotes microbial growth, and also does the extrinsic factor such as temperature.

Results from percentage occurrence showed that *E. coli* and *Samonella* sp. highly occurred in both samples, this was followed by *Pseudomonas* sp. and *Proteus* sp. and these were more in pork fat than beef fat. Yannick et al.[8] recorded 81.8% for *Staphyloccocus aureus*, 72.7% for *Klebsiella pneumonia*, 54.4% for *Escherichia coli*,45.4% for *Salmonella* spp., 27% for *Proteus vulgaris* and 9% for *Shigella* spp. TABLE 2 is a tabular representation of the percentage occurrence of both fats.

TABLE 2: Percentage occurrence of bacterial isolates from pork fat and beef fat

Isolate	Pork fat		Beef fat	
Proteus sp.	-	-	+	16.5%
E.coli	+++	56.0%	++	33.5%
Salmonella sp.	++	35.7%	++	33.5%
Pseudomonas sp.	+	18.3%	+	16.5%

It could be possible that after processing these fats that the bacterial load of these fats will reduce as a result of heating or other techniques used on it. It could also be possible that the microorganisms in these fats are also released into the environment when dumped. When deposited as wastes into the environment, these fats begin to decay and release offensive odor. The odor released could be as a result of the action of the microorganisms already present in the fat which most times begin the degradation process or as a result of the action of other microorganisms which find the fat as a source of energy. The tender nature of these fats may have contributed to the easy access of these microorganisms which when broken down will lead to more fat loving microorganisms inhabiting these fats.

Environmental factors such as sunlight and rainfall further promote the migration of the degraded fats and this could be beneficial or harmful depending on their quantity in the environment. When these fats are washed in small quantities into the environment, it is tolerated but when in large quantities, they will either compete or work in synergy with the existing nutrients in such

environment. The oil released by these fats cover the surface (water or soil) they occupy, thereby preventing such environment and the microorganisms in the environment from getting essential nutrients needed for their growth. This might be the reason for the awful odor given out by these wastes (fats). These decaying fats could trigger the degradation of other materials in the environment. The dumped fats and other wastes are not a sight to behold as it makes the environment look unhealthy. Ifeoluwa[23] stated that solid wastes lead to soil, air and water contamination which creates health challenges and is a major problem to man and its environment especially those who live closer to areas where these wastes release offensive odors as a result of decay.

CONCLUSIONS

There is a need to look into these fats to ascertain if they can be fully maximized to make other meaningful products**.** This will reduce the amount of unwanted substances and pathogenic microorganisms released into the environment and also promote a healthy environment.

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CONFLICTS OF INTEREST

The authors have no conflict of interest.

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