RESEARCH / INVESTIGACIÓN

Microbial implications of beef fat and pork fat in the environment

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Abstract: Developing countries are known to dispose of waste indiscriminately into their environment, off 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, which will reduce waste in the environment. Statistical analysis showed a significant difference in mean counts of pork and beef fat samples at $p \leq 0.05$.

Key words: 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 significant 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 due to the lack of technology to help reduce the heap of wastes[2]. Another global problem is soil pollution resulting from waste discharges freely dumped into the environment. The richest reservoir of microorganisms in the soil play a significant role in the ecosystem because its continuity depends mainly on it. If the soil becomes polluted, the ecosystem is tilted, and agricultural activities are disrupted[3,4]. A major problem of many urban areas in Nigeria is the low sanitary condition best described by Sule[5] as indiscriminate waste disposal and the ability to reduce it to the minimum and the low usage of laws for this waste disposal problem. These abnormal waste dumping methods have created many problems such as sanitation and environmental issues, an imbalance of groundwater, and soil pollution and water resources[6]. This pollution problem either on air, water, or land caused by man's day to day activities is rapidly growing to the point that it can no longer be managed and will be seen as a usual way of life. This issue hurts human health and well-being.

One of the by-products of animals is fat[7], and it can be edible or inedible depending on the animal and the animal's part it is gotten from. Cattle are a source of protein and fats[8]. Fat has an essential role in meat quality. Surface fat stops frequent cooling of the underlying muscle tissues, which lowers the tendency of cold-shortening and lowers weight loss due to chilling. The hardness or softness of fat directly impacts its processing efficiency also fat and adds to meat's beneficial properties. 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 approximately 12% moisture, and the connective tissue is approximately 3%. Different types of collagen and various cross-linking levels are crucial to the structure of fat tissue, and these affect the texture and strength of fat at any temperature, and it depends on the composition of its fatty acid and the molecules that constitute its triglycerides. Palmitic and stearic acids are saturated fatty acids with high melting points of about 65-70°C, and this account 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 significant contributors to the quality of pork fat[10]. Pork's quality may increase or decrease as a result of nutrition, genetics, management, and pork-processing procedures. Pigs' lean genotype fed with diets 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, which might negatively affect the processing, separation of tissue, and stability during storage. Several factors define Pork's quality, 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 represents the role played by each source of dietary fat[12,13,14].

Oleic and palmitic acids are the primary fatty acids in beef fat[15]. Many factors, such as the breed of Cattle, sex, diet, weight, age, fatness, and environmental conditions, including climate and season, are known to affect the composition of fat tissue in cattle. Although the factors do not apply to all cattle, the cattle known as Brahman are known for 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 significant role in the unsaturation of fat; the older an animal becomes, the more unsaturated fat it is likely to have. Colder climates are known to have Cattles with softer subcutaneous fat. When a healthy cattle grazes green pasture, it utilizes the yellow pigments in these plants known as carotenoids, beta-carotene, which makes up a larger part of carotenoids and gives the fat

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its color. Most fats are known to have a cream or yellow color.

This research aims to identify the impact of fats in the environment and the microbial load.

Materials and methods

Fat samples were collected from slaughterhouses in Umuahia, Abia State, Nigeria. These samples were collected in sterile polythene bags and transported within 45 minutes for microbiological analysis (Figure 1). 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]. The pour plate method was used to isolate microorganisms on MacConkey agar and Nutrient agar at 37oC for 24-48 hours. Pure isolates were identified and characterized. The other part of the fat that was not bought from slaughterhouses was 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 are shown in Figure 2. These samples had higher counts for total heterotrophic plate count than total coliform plate count.

Figure 2 shows that pork fat has a 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. 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 makes microorganisms thrive more in it. Lulietto *et al.*[19] stated that meat has high protein, lipids, minerals, and vitamin contents

Figure 1. Area of Study. Umuahia, Abia State, Nigeria.

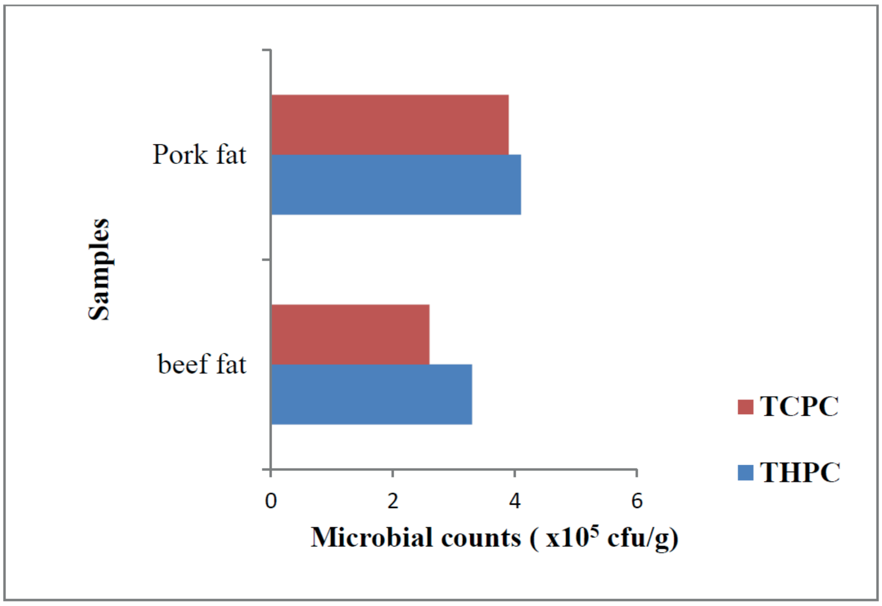

Figure 2. Mean bacterial counts of pork fat and beef fat.
THPC: Total heterotrophic plate count
TCPC: Total coliform plate count

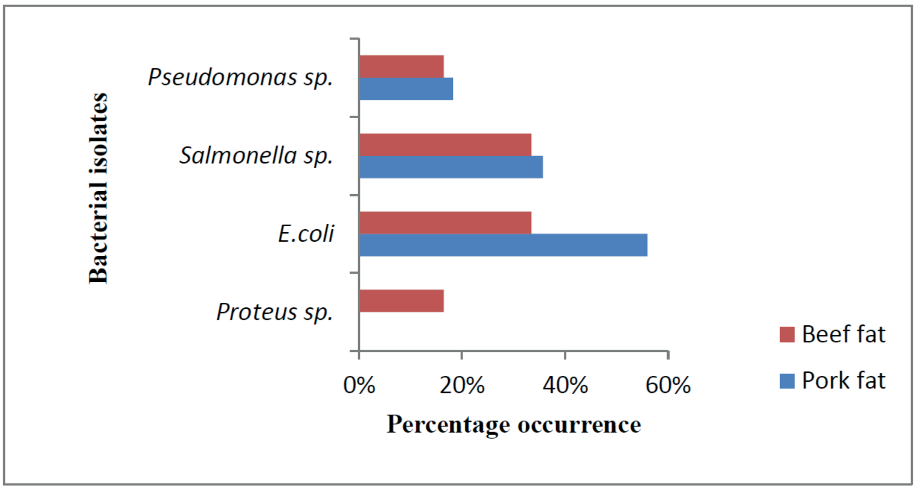

Figure 3. Percentage occurrence of bacterial isolates from pork fat and beef fat.

but low carbohydrate content, which allows some organisms to survive. Nychas *et al.*[20] recorded that meat spoilage results from 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 *Samonella sp.* in all fat and oil samples, including 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, *Pseudomonas sp.* and *Proteus sp.*, 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.* Figure 3 is a representation of the percentage occurrence of bacteria in both fats.

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 an offensive odor. The odor released could result from the action of the microorganisms already present in the fat, which most times begin the degradation process or the action of other microorganisms that find the fat as a source of energy. The delicate 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 an environment. The oil released by these fats covers the surface (water or soil) they occupy, thereby preventing such environment and the microorganisms in the environment from getting the 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 significant problem to man and its environment, especially those who live closer to areas where these waste release offensive odors a result of decay.

Conclusions

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Competing interest

The authors have no competing interests.

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