PROLIFERATION OF INSANITARY HANDLING OF MEAT AND INVASION OF MEAT SPOILAGE ORGANISMS IN SOUTH YORKSHIRE.

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ABSTRACT

The safety of food supply is another issue that has drawn the interest of people over the years because most people have had poor knowledge and practice in food safety. This is the reason millions of people get sick from the food they eat and that is why it is important we keep the food supply relatively free of harmful substances, such as some chemicals used to grow and process foods. Unsatisfactory level of meat hygiene and safety practices to a large extent is responsible for the high prevalence of food-borne diseases in Nigeria. Therefore, this study is commissioned to assess proliferation of insanitary handling of meat and invasion of meat spoilage organisms in South Yorkshire.

KEY WORDS: Meat hygiene, Microorganisms, Meat spoilage organisms

Introduction

The microbiological safety and quality of meat are important to producers, retailers and consumers, and both involve microbial contaminants on the processed product (Meadow, ۱۹۹۷). Food safety is a significantly and growing public health problem in our society (Okoli et al., ۲۰۰۷). Food safety is crucial if the environment in which the food is handled is heavily contaminated (Salvato, ۲۰۰۱). Most fresh foods particularly those of animal origin such as beef and poultry are highly susceptible to microbial invasion and food poisoning. The Federal Ministry of Health reported thousands cases of food poisoning in ۲۰۰۵ alone (Okoli et al., ۲۰۰۷). The World Health Organization estimates large number of deaths from diarrhea each year around the globe, as many as ۵۰% which may be attributable to contaminated food and water (Okoli et al., ۲۰۰۷). According to the World Health Organization (۲۰۰۵), animal- source foods are probably responsible for most of these cases of food-borne diseases. Food-borne diseases are responsible for high levels of morbidity in the general population, but particularly for infants, children, the elderly and the immuno-compromised (WHO, ۲۰۰۵).

According to Amadi (۲۰۱۱), food-borne illness is any illness resulting from the consumption of contaminated food which usually arises from the food people eat. The food may be contaminated with bacteria, viruses, parasites or viable worm cysts (Amadi, ۲۰۱۱). Bacteria which are responsible for food-borne diseases contaminate meat directly and indirectly especially from animal excreta during slaughter process (Oreyomi et al., ۲۰۰۲). Meat, fat and other parts of the carcass usually processed into used as meat products are mainly derived from the domesticated animal species such as cattle, pigs and poultry and to a lesser extent from sheep and goats (Gupta et al., ۲۰۰۵). In this context, meat can be defined as '' the muscle tissue of slaughtered animals'' (Gupta et al., ۲۰۰۵). As meat consumption is increasing around the world, so are the concerns and challenges of meat hygiene and safety (Jestro, ۲۰۰۱). A major goal of scientists, industries, public health and regulatory authorities is to control pathogenic microorganisms and improve meat hygiene and safety within a country and internationally (Jestro, ۲۰۰۱).

Statement of the Problem

Several outbreaks of food poisoning and food-borne diseases have been reported in our society, and these have been attributed mainly to the consumption of food contaminated as a result of compromised food hygiene practices by food handlers. Such unhygienic practices of meat and its products have led to many diseases. Mobility and mortality resulting from insanitary food handling is a major public Health problem in our society. Statistics has shown that diarrhea cases account for ۱۱X% of mortality (FAO/WHO ۱۱۰۰۱۱). The World Health Organization (WHO) estimated that ۱۱۰۰,۰۰۰ people died from diarrhea each year in our society (WHO, ۱۱۰۰۵), as much as ۷۵% of which may be attributable to contaminated food and water.

Information on meat hygiene

Although various foods serve has the primary route of transmission of food-borne illness, meat and meat products are important sources of human infection (Nworgu, ۱۱۰۰۷). Meat contamination has been associated with the following bacteria such as *Escherichia coli 0157:H7, Salmonella, Campylobacter jejuni, Listeriamonocytogenes,* which results to high mortality worldwide (Policy Guideline on Market and Abattoir sanitation, ۱۱۰۱۱; Jestro, ۱۱۰۰۱۱). Campylobacteriosis in human is caused by thermophilic *Campylobacter Spp* namely, *Campylobacter jejuni* and, to a lesser extent *Campylobacter coli* (Nascirnento et al., ۱۱۰۰۷). They are microaerophilic, very small, curved, thin, gram negative rods. It is considered by many to be the leading cause of enteric illness in the United States (Hunt et al., ۱۱۰۱۰). The symptoms are diarrhea (often bloody or watery), abdominal pain, fever, nausea and vomiting (National Environmental Sanitation Policy related laws, ۱۱۰۱۱).

Human Salmonellosis caused by *Salmonella Spp* is usually characterized by fever, diarrhea, abdominal pain and nausea. Symptoms are often mild, and most infections are self-limiting within a few days. Salmonellosis has also been associated with chronic sequelae like arthritis (Terefe + Welle, ۱۱۰۰۵). *Escherichia coli* is a facultative anaerobic bacteria which are straight rods and non-motile. Although most strains of *E.coli* are harmless, others can cause illness in man (CDC, ۱۱۰۱۱). For example *VerocytotoxigenicE.coli* (VTEC) is a group of E. coli bacteria that are characterized by their ability to produce *verocytotoxin*. VTEC ۰۱X۷ which is the most frequently reported *E.coli* strain associated with human disease. The symptoms associated with VTEC in humans are mild to bloody diarrhea often accompanied by severe abdominal cramps. Listeriosis is a disease caused by infection with *Listeria monocytogenes*. It is a gram positive facultative intra cellular food-borne pathogen often found in food, mainly meat (Litchfield, ۱۱۰۰۰).

In addition to the spread of food-borne pathogens, meat is also susceptible to spoilage when it is exposed to spoilage microorganisms. Meat is considered spoilt when it is unfit for human consumption (Okonko et al., ۱۱۰۱۰). Fresh meat has a high water activity and a P^H between ۷.۷ and ۷.۵. A variety of factors can cause meat to spoil including microorganisms, exposure to air and improper freezing techniques (Omoruyi et al., ۱۱۰۱۱). Indications of spoilage are ammonia or sulfur smell, bad odour, tallow or chalky taste. At temperature < ۱۰°C, spoilage of meat is mainly due to psychotropic bacteria. Spoilage usually begins to be evident when the number of bacteria reaches $۱۰^۷$/cm^۲. This is accompanied by discoloration and typical spoilage odour. A consortium of bacteria, commonly dominated by *Pseudomonas Spp*, is in most cases responsible for spoilage of meat stored aerobically at different temperatures.

Meat is sold in the markets and directly from abattoirs. In poorly managed market environments, unhygienic practices are the major causes of food contamination (Omotayo, + Denloye, ۱۱۰۰۱۱). A visit to some of the markets in South Yorkshire shows a low level of sanitary condition. There is indiscriminate disposal of refuse even at the very point where meat is sold. The abattoir also serves as a meat market for wholesale supply chain. The instruments used in dressing and killing,

various receptacles and the personnel may all act as sources of contamination during slaughter. After leaving the abattoir, the beef carcass is exposed to various factors- for example, transport from abattoir to retail, handling and the environment). Some of these practices may lead to the introduction and spread of pathogens and spoilage microorganisms from a diversity of sources.

Investigators such as Iroha et al (IIOIO) have reported outbreaks of food-borne infections occasioned by insanitary handling of meat at the abattoirs and most markets. This study shall contribute to the data of bacteriological qualities of meat sold in selected markets. Recent increase in the consumption of meat and its product arise from reasons including high protein contents, vitamins, minerals, lipids and savory sensation (Iroha et al., IIOII). Meat has been defined as the flesh of animals which are suitable as food (Achalu, IIOOV). This includes all processed or manufactured products which might be prepared from these tissues; i.e., meat may be fresh, cured, dried or otherwise processed. Meat is particularly important in human nutrition, because it contains high amount of exogenous amino acids (Oreyomi, IIOOX). Meat means all striated muscle tissues that come about naturally together with connective tissue; lax, fibrous, cartilage, fat, bone and nerves, blood vessels and lymph nodes. The major primary unit of meat is called carcass. It represents the ideal meat after head, hide, intestine, blood (Okonko et al., IIOIO). The edible parts of a carcass include lean flesh, fat flesh and edible glands or organs such as heart, liver, kidney, tongue and brain. Meat, fat and other carcass parts used as food or as raw material for the manufacture of processed meat products are mainly derived from the domesticated animal species such as cattle, cows, pigs and poultry and to a lesser extent, from buffaloes, sheep and goats (Gupta et al., IIOOC).

Meat is processed in abattoirs. Meat has long been known for its nutritive composition which explains the rate of consumption by people globally (Balch+ Balch, IIOOO). The nutrients contained in beef are water (CII.IIX- CIII.OL%), proteins (IIV.OIII-IIX.IIM%), fat (III.MI-V.VO%), minerals (O.DIII-I.OV%) and a few of carbohydrates (CDC, IIOII). Meat is considered as an ideal culture medium for growth of many organisms because of the high moisture, high percentage of nitrogenous compounds of various degree of complexity, plentiful supply of minerals, accessory growth factors and some fermentable carbohydrates of favorable P^H for most of the enteric microorganisms. There is the preferred consumption of different types of meat by communities. This may be due to a combination of a number of factors bordering on religious belief, culture, adaptability, food habits, age, sex, socio-economic facts and individual variations (Anwan + Okaka, IMMX). Cow meat appears to be predominant though sheep, goat and poultry meat are widely accepted (Alakija, IIOOII).

Microorganisms found in meat

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The muscle of a healthy animal is sterile, but even under the most stringent conditions, muscles can become contaminated during the harvest process from the environment, hide, or from direct contact with the intestinal tract contents of the carcass (Heinz + Hautzinger, IIOOC). Contamination of meat with food-borne pathogens remains an important public health issue, because of the illness associated with unsanitary practices employed in the processing, distribution, handling, and cooking of the products (Oreyom, IIOOX). Bacteria for instance as one of the types of microorganism responsible for food-borne diseases can contaminate meat directly and indirectly especially from animal excreta during slaughter processes.

Meat is the most perishable of all important food since it contains sufficient nutrients needed to support the growth of microorganisms (Okonko et al., IIOIO). Meat is also a rich matrix that provides a suitable environment for proliferation of meat spoilage microorganisms and common food-borne pathogens (Okonko et al, IIOIO). Fresh meats become contaminated with microorganisms during slaughter and dressing processes. When carcasses leave an abattoir, they are invariably contaminated with microorganisms during the distribution of meat to the consumers; the storage

conditions of the meat at the retailer's stall or shop also contributes to the increase in microbial numbers in the meat (Spiegel, + Stephens, IMMD). The development of the microflora on the meat surface depends on the storage conditions, in particular on gaseous atmosphere during storage (Bakker, IIOOX).

Beef can be a source of food-borne illness especially under the condition in which meat animals are handled, slaughtered, transported and sold on markets. Meat and meat products are potential sources of risks for specific species of bacteria like *Clostridium perfringes, Campylobacter jejuni. Escherichia coli 0157:H7, Staphylococcus aureus and Salmonella.* There are more than IIXO known food-borne diseases caused by bacteria, viruses, parasites, such as *Escherichia coli 0157:H7, Listeria monocytogenes, Campylobacter jejuni, Clostridium perfringes, Salmonella Spp, Toxoplasma gondii , Staphylococcusaureus, Taeniasolium, Aspergillus Spp, Norovirus, Rotavirus* (Amadi, IIOII). Okonko et al (IIOIO), reported that the most predominate coliform identified on meat were *Klebsiella pneumonia*, followed by *EnterobacterSpp, Citrobacterfreudii, Pseudomonas aeruginosa, Escherichia coli, Salmonella Spp, Serratiamarcescens* and *Pseudomonas Spp; Proteus vulgaris* was the less predominate. The bacterial species isolated from beef sample by Callaway et al (IIOOV) were *Escherichia coli, Streptococcus Spp, Salmonella Spp, Staphylococcus Spp.* Contamination of meat with these food-borne pathogens remains an important public health issue, because of the diseases and the death associated with it (Nwanta, IIOOD).

Meat carcase on

Salmonellosis is the leading cause of food-borne disease in several countries, sometimes accounting for the highest morbidity and mortality rates among food-borne pathogens (Alonge, IIOOX). In the United States, the outbreaks of non-typhoidal Salmonella infections and sporadic illness have been associated with a variety of causes particularly foods of animal origin. Salmonellosis is caused by *Salmonell*a Spp; it is a gram negative facultative rod- shaped bacterium in the same bacterial family as *E. coli*, the family bacteriaceae, trivially known as '' enteric'' bacteria. Salmonella causes a wide spectrum of diseases ranging from enteric fever, bacteriamia, focal infection, to a convalescents lifetime carrier state (David-West, IIOOII). Human salmonellosis is usually characterized by fever, diarrhea, abdominal pain and nausea. Salmonellosis has also been associated with chronic sequelae like arthritis (Norrung et al., IIOOD).

Escherichia coli are widespread gut commensal organism of man and warm-blooded animals. E. coli is a facultative anaerobic straight rods and non-motile bacteria. They are a large and diverse group of bacteria. Although most strains of E. coli are harmless, others can result in illness (CDC, IIOII). Dangerous strains such as E. coli OIXC:HC and E. coli OIOV:HV can cause bloody diarrhea, kidney failures and death in extreme cases. E. coli OIXC:HC (designated by its somatic O, and flagellar H antigens) was first recognized as a human pathogen following two haemorrhagic colitis outbreaks in IMDII (Eriksen, IIOII). E. coli OIXC:HC occurs as a verocytotoxin producing species (VTEC). VTEC cause diarrhea and haemorrhagic colitis in humans and can lead to potentially life-threatening sequelae such as haemolyticuraemic syndrome and

thrombotic thrombocytopaniae purpura (Mead, ۲۰۰۷). Food and water are probably the main vehicles of VTEC transmission (Amadi, ۲۰۱۱).

Listeria monocytogenes is one of the most important food-borne pathogens, having the highest mortality rate (۲۸.۲%) among all food-borne bacterial illnesses between ۱۹۸۵ and ۲۰۰۲ in the United States (CDC, ۲۰۱۱). Listeriosis is a disease caused by infection with *Listeria monocytogenes* . It is a gram positive facultative intracellular food-borne pathogen often found in food (Rothschild, ۱۹۸۸). It is an organism commonly associated with food-processing environment and ready-to-eat foods (Jovane et al., ۲۰۰۳). It is naturally found in soil, dust, ground water and animal faeces, and may also be on unwashed raw produce, raw meat, processed food and prepared meat (Amadi, ۲۰۱۱). *Listeria monocytogenes* can produce infections in susceptible human populations, such as immunocompromised people, infants and pregnant women. The symptoms may range from mild flu-like symptom and diarrhea to life threatening forms characterized by septicaemia and meningitis.

Campylobacter remain highly important zoonotic pathogens worldwide which infect an estimated ۱% of the population of the Western Europe each year (Tom et al., ۲۰۰۶). *Campylobacter jejuni* is a microaerophilic, very small, curved, thin, gram negative rods (Terefe + Welle, ۲۰۰۹). *Campylobacter jejuni and coli* are often responsible for causing Campylobacteriosis in human the most common bacterial form of acute infective diarrhea (Swedberg., ۱۹۸۷). It can diffuse and spread from contaminated raw poultry via hands and food contact surfaces. The symptoms are diarrhea (often bloody or watery), abdominal pain, fever, nausea, vomiting (Policy Guideline on Market and Abattoir sanitation, ۲۰۱۱). It is the most common cause of diarrhea in the United States; over ۱۱ million cases are reported each year (CDC, ۲۰۱۱).

Staphylococcus intoxication is a leading cause of food-borne intoxication. Two enterotoxigenic*Stapyhlococcus* strains have been isolated from foods implicated in illness. *Staphylococcus aureus* is a gram positive facultative, catalase positive, non-sporing and non-motile coccus. It is a bacterium that normally colonizes human skin and mucosa without causing any problems. *Staphylococcus aureus* also produces toxins, which if the bacteria contaminate unsanitary prepared food can cause food poisoning. Rotaviruses were discovered as the cause of infantile human gastroenteritis in ۱۹۷۳, the virus is also known as the cause of acute gastroenteristis in young animals. It has been found to be the main aetiological agent of gastroenteritis in infants and young children globally (Amadi, ۲۰۱۱). Cryptosporidium is a small coccidian parasites. The microorganism is acquired by ingestion, contaminated water. Infection from human to human also seems to be common. The organism causes severe diarrhea (Amadi, ۲۰۱۱). Meat which supports the spread of food-borne pathogens is highly susceptible to spoilage (Okonko et al, ۲۰۰۹).

Meat spoilage organisms

Beef is a high protein food which is widely consumed by the majority of the urban populace; its high nutritional content makes it susceptible to microbial invasion and subsequent deterioration (Roth, ۲۰۰۳). The presence of pathogenic and spoilage microorganisms in meat and its by-products remains a significant concern for suppliers, consumers and public health officials worldwide (Oboegbulem + Muogbo, ۲۰۰۹). Meat spoilage is not always evident, and consumers would agree that gross discoloration, strong off-odor, and the development of slime would constitute the main qualitative criteria for meat rejection (Roth, ۲۰۰۳). In general, spoilage is a subjective judgment by the consumer, which may be influenced by cultural and economic considerations and background as well as by the sensory acuity of the individual and the intensity of the change (Roth, ۲۰۰۳). Spoilage results mainly from ''off-odors'' development, and product shelf-life is determined both by the number of spoilage organisms present initially and the temperature history of the product at all stages of production and handling (Oboegbulem + Muogbo, ۲۰۰۹).

Meat is said to be spoilt when it is unfit for human consumption (Okonko et al., 2010). Meat is recognized as one of the most perishable foods and refrigeration temperature are always used to delay spoilage of fresh meat. Fresh meat has a high water quality and a P^H between x.x and c.o (Oboegbulem + Muogbo, 2008).). Spoilage of meat can be considered as an ecological phenomenon that encompasses the changes of the available substrate (e.g. low molecular compounds) during the proliferation of bacteria that consist the microbial association of the stored meat (Oboegbulem + Muogbo, 2008).). Among the factors that affect microbial growth in meat are intrinsic properties (physical and chemical properties of meat), and extrinsic (environmental factors). However, the factors having the greatest influence on the growth of microorganisms in meat and meat products are the storage temperature, moisture and oxygen availability (Okonko et al., 2010). The development of organoleptic spoilage is related to microbial consumption of meat nutrients, such as sugars, and free amino acids and the release of undesired volatile metabolites (Litchfield, 2000).

Microorganisms commonly associated with meat include majorly the psychrophiles of the *genera Pseudomonas, Lactobacillus, Moraxella, Acinetobacter, Microbactria, Brochotrix, Klebsiella and Vibro.* The mesophiles include *Salmonella Spp, Escherichia coli, Clostridium perfringens, and the thermophiles include Streptococcus faecalis*; others include members of the genera *Flavobacterium, Bacillus, Leuconostoc, Proteus, Micrococcus* and *Achromobacter* (Litchfield, 2000). The common moulds on meat are the genera *Cladosporium, Sporotrichum, Oospora, Thamidium, Mucor, Penicillium, Alternaria and Monilia.* The yeasts found on meat are majorly of the Asporogenous genera and include *Torulopsis, Rhodotorula and Candida* (National Environmental Sanitation Policy, 2008). Temperature seems to be the most important factor that influences the spoilage as well as the safety of meat. Meat spoilage bacteria will grow if temperatures are not kept in the cooling (-1°C to 7° C) or freezing (below -1°C) range. Not all bacteria which contaminate meat will behave in the same way some may multiply already at temperature at around 10°C, others at higher temperatures. At temperature less than 10°C, spoilage of meat is mainly due to growth of psychrotrophic bacteria. Although the European Union Legislation requires a maximum final meat temperature of c°C before transport or cutting (George et al., 2000). The P^H of food is critical because at low levels, it favors the growth of moulds and yeasts. In neutral or alkaline P^H foods such as meat and meat products, bacteria are more dominant in spoilage process (National Environmental Sanitation Policy, 2008). The high protein content of meat makes the P^H approximately neutral and it leads to a high level of spoilage in the meat and this is further explained by the breakdown of muscle glycogen leading to the production of lactic acid in the muscle fibers (Soyiri et al., 2000). Meat products, unless appropriately packaged, transported and stored, spoil in a relatively short time (Tovel, 2001).

Conclusion

From the study, it was concluded that meat contamination and pollution can also facilitate the development of non-communicable diseases. Therefore, the hygiene of food handling is a vital aspect of environmental health services that needs to be taken seriously by most operators of such business. So that deteriorating food hygiene situation as seen in many restaurants, fast-food centers, hotels, markets, domestic kitchens and other food handling concerns will be minimized.

Recommendation

1. Policies should be promulgated that will promote health, control food-borne diseases, minimize and finally eliminate the risk of diseases related to poor food hygiene practices.

II. Food handlers should undergo medical test before serving the people and also go for routine test every year.
III. Government should build standard abattoirs in all major markets in the country.

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