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Review Article

Effects of bacterial contamination on Meat Decomposition

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Contents

ABSTRACT

Microorganisms, mainly bacteria are playing a major role in meat decomposition. The consumption of such microorganisms' posses' public health hazard and challenges to related expertise. Among the bacteria that had been isolated from decomposed meat are *Pseudomonas fluorescence* and *Proteus mirabilis as well as zonootic pathogens such as Salmonella typhimurium and Staphylococcus aureus*. The growth and survivability of meat contaminants depends on the virulence of the microorganisms and the microenvironment (hydrogen, humidity, oxidation-reduction process, temperatures) that support their metabolism and growth. A room temperature of 20- 25^{o} c has been shown conducive for bacterial growth unlike a cooling temperature of 8 degrees. Studies have shown the penetration of *Staph. aureus* through the surface of meat depends on the virulence factor of the bacterium and the environment where the meat is stored. Certain bacteria like *S. typhimurium and Staph. aureus* have the potential to invade more than other bacteria. Researchers in this field did not indicate any consequential discrepancies in the penetration process between lamb and beef meat with the type of bacterium involve in the penetration process. However, fat present in meat either lamb or beef is a natural barrier to penetration into meat which slowdown the penetration process of bacteria. This paper provides an overview of the contamination of meat by pathogens that penetrate and promote decomposition and spoilage of meat and thus affecting quality.

Keywords: *Animal meat, Bacteria, spoilage, Penetration.*

Introduction

The meat with associated products is considered to be one of the main food resources of protein. Following the slaughtering process, the animal muscles will change physically, and chemically in which eventually will turn into meat. Such meat are produced from healthy

uncontaminated animals, but sometimes the meat gets exposed to so many contaminants during the slaughtering process inside the slaughterhouse and during transportation to the market to be consumed by consumer. Such contaminants are internal (resources from animals) or external (environmental pollution, tools and labours). The hazards of such bacterial contaminants lie on their capabilities in decomposing meat as well as the possibilities of risking humans' health. The bacteria exist either on the surface of the meat or rarely inside the tissue of the meat, especially if the meat is a carrier of such bacteria, or transporting contaminants via blood to the muscles during slaughtering. The bacteria found on the meat surface are the most obnoxious which are able to stick on the surface of the meat to be later on developed and multiply, into suitable nutritional and conducive environment. Following the sticking process on the surface of the meat, some bacteria are capable to penetrate the muscle tissues depending on several factors, mainly on their abilities to produce the required enzymes to invade the tissues in order to gain the energy and growth from the meat. The main factors in facilitating or impeding the penetration process of meat through their natural shield which include connective tissue, fat, hydrogen, humidity, oxidation reduction, temperature and water. The penetration mechanism of bacteria inside the tissue of the meat has not been comprehensively studied. Available documentations lack information on factors that affect the penetration process of bacteria into meat tissue. To understand the penetration mechanism or to control or impede the bacteria to reach the tissue inside the meat such information is important. This review is therefore designated to highlight the penetration mechanism and the capabilities of a certain bacterial pathogens in penetrating the surface of the meat into the tissue to effect its decomposition.

The Meat

Meat mainly consists of muscles but different quantities of various types of other tissues as well as epithelial and neuronal tissues are present. The structural muscles are considered to be the key source for the muscle tissue in meat but there are little amount of smooth muscles within meat. In addition, there are also bounding tissue such us connective tissue, adipose or fatty tissue, bones, and cartilages that are commonly existed (Aboud, 2000). The connective tissues which separate muscles into bundles (bounding tissue) are called epimysium. Each bundle is surrounded by a connective tissue called perimysium, and each bundle consisted of a number of muscle cells separated from each other by a layer of connective tissue called endomysium. Each single muscle cell is called myofibril. The myofibril consist of dark and light zones, which are well organized and arranged in sequence, the dark colour represents A-Band protein myosin whilst the light colour represents I-Band protein actin ((Bradbury, 1975). Fat significantly affect the smell as well as the taste of meat (Thornton and Gracey, 1976) and is important for activation of biological processes in the body. The body needs adequate proteins (amino acids) to build the body but in balanced proportional rates with other nutrients to cover human needs (Rashid, 1993). The economic status of a country is measured by the people’s consumption of meat (Tahir, 1983).

Transformation of muscles to meat

The physiological change of skeletal muscles to meat as food for human consumption is the transformation process of muscles into meat. Muscles tissues do not stop their physiological and chemical activities immediately after slaughter but these activities continue for some time. Following slaughter blood is adequately drained by exsanguinations, the event which exerts considerable pressure on the slaughtered food animals. As the blood pressure start decreasing after slaughtering, the circulatory system will adapt where the heart will start pumping more blood in the body resulting in shrinkage of the surface veins in an attempt to keep the blood pressure stable and maintain blood flow to the organs (Bodwell *et al*. 1965). In fact, only 50% of blood can be removed from the body, while the rest of the blood remains in the organs including the muscles which are very vital to produce the meat. The blood is a good culture media for the growth of microbial agents that cause damage to muscles and meat (Buttaux and Catsaras, 1966). Following the exsanguinations process, the body through the circulatory system loses control of the temperature of muscles. Therefore, the temperature of muscles is escalated soon after exsanguinations. The size and location of muscles, and the amount of fat covering the muscles will determine the final temperature of muscles (Mies *et al*. 1999). The stored temperature used for the fresh meat may, on limited basis, affect the chemical reactions in the muscle tissue. Such reactions will help cellular and bacterial enzymes to be more sensitive to temperature following slaughter (Gill *et al.* 1991). Therefore, after the slaughtering, it is recommended not to immediately store the fresh meat at a low temperature but after certain time to allow muscle to meat transformation to take place in order to ensure meat of good quality (Al-aswad, 1989). The hydrogen ion concentration is one of the main factors that determine the best time of storage of meat that will eventually affect the quality of meat especially for freshness (lienness) condition. Whelean *et al.* (1986) has indicated that the usual hydrogen ion concentrations in the muscles are (6.8-6.9), and after slaughtering will be in the neutral limit and then two hours later, become acidic. It has been found that hydrogen ion concentration become 6.9 and reached 6.0 after 24 hours until 96 hours after slaughter. Rise of hydrogen ion concentration after slaughter is due to protein lysis and disappearance of lactic acid. Animals' meat varies in their final hydrogen ion concentrations following rigor mortis, but there are no significant differences among muscles of the same animal and the hydrogen ion concentration is mainly affecting the early stage of aging due to the effect of lactic acids in the muscles (El-Iraqi *et al.* 1970). The continuation of natural meat protein lyses by the auto activity of catheipsin enzymes during the following period will result in the increase liberation of amines groups which lead to increase hydrogen ion concentration through the rest period of aging (Buton *et al.* 1971). The internal humidity is one of the main components of meat and its products. It provides a conducive environment for biological reactions and it significantly affects the quality of meat during storage and manufacturing processes. The growth of bacteria which is either contaminating the surface of the meat and that can penetrate or causing infection (Gill, 1979) can be influenced by humidity. The proteins are the main components that are connected to water in living creatures. It is predictable that muscle’s proteins are bounded to water to form a layer called bound water which is very difficult to separate from the meat. Another layer of water in meat is called immobilized water which is less connected to meat in comparison to bound water. Free water is another layer which has the least connection to the meat due to the force of surface tension. Some other important changes that happened following the slaughtering

process, that makes the meat more tender and juicy with acceptable taste and smell, are the bulge of collagen and lyses of muscles and components by natural catheipsin enzyme that exist in meat or by other enzymes which is secreted by certain bacteria (Koohmaraie, 1992; Koohmaraie *et al.* 1995; Quali, 1990; Goll *et al.* 1983; Penny, 1980). The maturity or stiffness period (ripening) depends upon the type of slaughtered livestock and the grade of fattening prior to slaughter, in addition to the main factor which is the surrounding (environmental) temperature. Whenever the temperature is higher, maturity period will be less and *vice versa* (Fujmaki *et al*. 1965; Bail *et al.* 1978; Chen *et al.* 1981).

Sources of meat pollution

Muscle tissue of an animal does not normally contain bacteria (Elmssalami and Wassf, 1971), and even saprophytic bacteria that cannot live inside such tissues. Whereas the white blood cells with antibodies formed in the living body of an a live animal are working efficiently in controlling and defending the body against infection; but these defensive mechanisms is lost when blood is drained at slaughter. At the time of slaughter, the meat is exposed to several bacterial contaminants (Mackey *et al.* 1980) from various sources where he most important ones are the skin, hooves, and gut remains (Samuel *et al.* 1980; Smeltzer *et al.* 1979; Who, 1988; Watson, 1981) as well as knives, tools, carcase saw, tables and other surfaces related to slaughtering process (Peel, and Simmons 1978; Widders *et al.* 1995), labours with their clothes, water, dust, insects, transportation and storage (Scarafoundi, 1957; Ayres *et al.* 1980; Fields, 1979; Pether and Gibert, 1970). The contamination with bacteria happens through spirant spots during the slaughtering process of preparing the meat (Peel and Simmons, 1978). The contamination of slaughtered meat may increase several times during the slaughtering process, depending on the health of operators and safety conditions applied on the tools used for slaughtering (Smeltzer *et at.* 1980). Roberts (1980) has indicated the role of knives in transferring *Salmonella* spp. to non-infected meat during the slaughtering process. A study by Peel and Simmons (1978) has proven the significant role of knives in transferring *Salmonella spp* to the non-infected meat during the slaughtering process from knives used for removing the skin (bacterial contamination was 66%), and those used for chopping the meat where the contamination of germs was 11%. It was evident that skin is the main source of Salmonella contamination. Duncan (1970) observed that *Staph. aureus* is widely spread in nature and significantly contaminating meat. Human (slaughter house workers) can be an important medium in transferring disease pathogens to meat, which is commonly found in the throat, pharynx and nose associated with respiratory illness by sneezing or coughing of the infected personal. During chopping and transportation, bacteria that can grow and release intestinal toxins can be derived from labours who are carriers (Bryan, 1980). *Staph. aureus* can be isolated from the surfaces of manufactured tools for meat processing which indicate that the non-hygienic tools and poor health of slaughter house operators are the main contaminators of meat (Minor and Marth, 1976; Muhammad *et al.* 2011; Muhammad *et al.* 2012) *Proteus spp which* are widely spread in nature and in the excreta of man and animals as well as in the urinary tract may easily find its way to the meat (Khalif *et al.* 1985). *Pseudomonas spp* saprophytes are also widely found spread in the soil, water and human intestine that can play their role in reducing the quality of meat (Al-Hadithy, 1986). It is

proven that such bacterium which is available in the soil, water and plants can easily contaminate meat (Rahme *et al.* 1995). The meat and food products become vehicles of such bacteria through handling, dirty clothing, chopping meat by contaminated tools and dirty contaminated slaughter houses.

Adherence of bacteria and contaminant on the Surface of meat

The mechanism of germs adherence on the surface of meat is represented by two consecutive steps (Firsternberg *et al.* 1987). The first preliminary step is attachment which is mainly attributed to the physical strength and the number of bacteria which are proportionally commensurate with the number of bacteria on the thin water layer at the outer surface of meat. The second step represents the increase strength of bondage and attachment due to the formation of extracellular polysuccharied which is called glycocalyx. It is a process which especially depends on time factor. In general, the attachment process depends on several factors which are mainly the movement of bacteria and the existence of pilli as well as the surface of meat of different animals and temperature (Lij and Sborough, 1999). A study conducted on meat taken from hen's breast has proven that these surfaces are the best places for adherence of many types of bacteria's (Firsteberg *et al.* 1987). However, there is a relationship between the concentrations of bacterial adherence on hen's breasts and the time of exposure to pollution (Butler *et al.* 1979). This adherence did last for a longer time while on other surfaces such as beef surface, adherence with *Pseudomonas* and *E. coli* did last only for a few minutes whereas with *Lactobacillus* and *Staphylococcus* the adherence process increased with slow pace after a few minutes of exposure to these bacteria (McMeekin and Thomas, 1978). There are different points of view regarding the role of flagella in adherence. Some indicated that its existence significantly increased the adherence process on meat surfaces while others exclude the important roles of flagella on bacterial adherence (Marshall and Mitchell, 1971; Fletcher and Floogate, 1973). Other factors that can contribute to adherence are the ability of bacteria to release extracellular nutritional substances such as carbohydrate which vary from one bacterium to another. The formed bacterial colonies on the surfaces of the meat depend mainly on the availability of nutrition. If there is adequate nutrition, then the bacteria will form colonies, but if there is a limited amount of nutrition, then the bacteria will form viscoelastic materials and fibres in order to protect themselves as well as to concentrate the nutrition. On the other hand, these materials will help the sticking mechanism of these bacteria on the external surfaces of the meat (Rogers, 1979).

Process of penetration of bacteria inside meat

The spread of bacteria inside the living body of an animal is made possible through their movement in lymphatic's and blood vessels as well as through connective tissues and not through muscle fibres (Frazier and Westhoff, 1988). Muscles do not normally contain bacteria, as they usually cannot survive inside these tissues except when infection (Malachov, 1965). The main problem is the growth of bacteria on external surfaces of meat which can affect the qualities and causing spoilage of meat (Maxcy, 1985). A study confirmed that the spoilage of meat was due to the existence and proliferation of bacteria on the external surfaces of meat and not all bacteria can penetrate and survive in meat (Dezukniga *et al.*

1991). Although considerable number of bacteria can survive on external surfaces of meat, the penetration process of the bacteria will take its course very slowly. Meat can change colour with foul smells with bacteria in depth of 1-2 cm only. Bacteria stabilize on the external surface of meat do not normally penetrate except when supportive factors that assist the penetration process are present. Pathogenic microorganisms either adhere or are trapped at the superficial folded natural biological structures and components of animal meat and which are crucial locations for growth and penetrations of these microorganisms (Jay *et al.*, 2000; Mossel *et al.* 1995). Salmonella bacterium could penetrate turkey meat at a depth of 1cm per one minute at a temperature of 4^{o}C. This bacterium can also penetrate harvested meat after 20 minutes contamination in the state of air vacuumed (Warsow *et al.* 2002). *E. coli* could penetrate the external surface of fresh beef meat to the depth of 30 micrometer after one minute of contamination (Prchalyo and Mclandsorugh, 2002). *Pseudomonas, Proteus*, and *Salmonellae spp* could reach to the depth of 3cm after 12 hours at a temperature of 7^{o}C and until 5-3-5 cm consecutively at a temperature of 30^{o}C, while *Streptococcus pyogenes* could penetrate only to the depth of 1cm at 7^{o}C and reached 3 cm in depth after 12 hours at a temperature of 30^{o} C (Elmossalami and Wassf, 1971). Fat and low temperature affects the penetration process, on meat without fat and meat with fat at temperature 4-8°C (Muhammad *et al.* 2012). *Salmonella typhimurium* and *Proteus mirabilis* were able to penetrate deep into the meat without fat at room temperature. Whereas, *Staph. aureus* was able to penetrate in the first hour only. In an experiment where after several hours, different layers of meat were sliced, homogenized with 10 ml of peptone water, and a loop full of the homogenates was streaked on agar plates to determine the penetration ability of the bacteria. At lower temperature, all bacteria were unable to penetrate except for *Proteus mirabilis*. The penetration of bacteria effect the quality of meat during the storage. *S. typhimurium and P. mirabilis* was known to be highly motile that can influence the spread of penetration (Toguchi *et al.* 2000; Pearson *et al.* 2008). These bacteria also actively produce proteolytic enzymes that enable them to penetrate the meat. At low temperature, the bacteria will reduce its cell size, the growth rate and the motility rate (Price and Sowers, 2004). Therefore the penetration rate at lower temperature environment was reduced. A study using Blue Lake-dye revealed that fat-covered meat was resistant to bacterial penetration (Anderson *et al.* 2007). The bacteria must be able to utilized lipid in order to penetrate through fat. This showed that *E. coli* grew on the surface but did not penetrate the meat. In addition, motile bacteria like *S. typhimurium* and *P. mirabilis grew* well on the surface and penetrate the meat. However at low temperature, the penetration rate of these bacteria was greatly reduced.

Mechanism of penetration

There are several factors that affect the penetration process of bacteria. The most important factor is the physical destruction to the surface of meat during transportation or during slaughter house activity such as chopping which assist penetration. Following penetration, the growth of microorganisms relies on the nourishment inside the meat to facilitate the penetration process (Thomas, 1966). The penetration of bacteria into the meat will result in destruction of the muscles fibres by the proteolytic enzymes discharged by these microorganisms (Gill and Penny, 1977). The penetration process is different and varies

between motile and non-motile organisms. The motility of bacteria inside meat is considered to be the physical strength that assists such penetration. The bacteria can also destroy the fat that covers the surface of meat by lipase enzyme resulting in water lyses or oxidation of fatty acids. Moreover these enzymes will also dissolve fats into glycerol as well as fatty acids, but in the case of phospholipids, fats will be turned into nitrogen and phosphorous bases (Gault, 1992). Despite the destruction phase which is a slow process, it may eventually pave the way for the organisms to penetrate inside the animals' tissues (Elmossalami and Wassf, 1970).

Factors affecting the mechanism of penetration

It has been indicated by many researchers that microbial penetration of meat depend on several factors such as temperature, humidity, hydrogen ion concentration (pH), oxidation reduction process, type of organism, the type of animal meat, and the size of the cut meat pieces (Locker and Daines, 1976; Malachov, 1965) .

Temperature: temperature is one of the important physical factors that can influence the growth of microorganisms. Cooling the meat will slow-down microorganism's growth is proportional with the decrease of temperature (Al-Delaimy and Stiles, 1975). The growth of microorganisms will stop at frozen temperature and microbial growth will slow-down during storage at chilling temperature (Reddy *et al.* 1978). Low storage temperatures of meat can significantly affect the microorganism's metabolism, due to the arrest of biochemical and enzyme activities of microorganisms at low temperature (Haines, 1938). Prolongation the validity of red meats by cooling can reduce pollution levels, growth of bacteria in slaughtered meats or to stop the proliferation of microorganisms (Holzer and Ring, 1998). Frosted meat will reduce microbial proliferation by affecting the metabolism of bacteria cells (Aboud, 2000) (Rey *et al.* 1971). Meat quality can be prolonged by cooling during storage by reducing the contamination and proliferation of bacteria in the meat after slaughter as well as to stop the growth of microorganisms after chopping and manufacturing. Temperature can significantly affect *E. coli* ability to penetrate meat (Takeuchik and Frank, 2001). *Salmonella typhimurium and Salmonella enteritidis* could penetrate fresh red meats, at the temperature of 30^{o} C, to the depth of 5-10-15 cm following 12-24-36 hours consecutively. With the meat stored at 7-10 ^{o}C, the ability of *S. typhimurium and S. enteritidis* to penetrate in the depth of 3-5-10 cm following 12-24-36 hours was reduced consecutively. Meat stored at 7-10^{o}C , cause slower bacterial penetration and the organisms were isolated at 3-5-10 cm after 12-24-36 hours consecutively and stayed at the same depths after 60 hours storage at less than 10^{o}C, but penetrated at the depth of 15cm when stored at 7^{o}C after 48 hours (Elmossalami and Wassf, 1970). *Proteus mirabilis* was slower than *S. enteritidis and P. vulgaris*, to penetrate at depths 3-5-15 cm after 12-24 -36 hours consecutively when meat was stored at 7^{o}C, and to the depth of 10cm after 60 hours when stored at less than 10^{o}C . Also the study showed that S. *typhimurium can penetrate meat* after 16 hours when stored at 37^{o}C , after 24 hours when stored at 30^{o}C and also after 40 hours when stored at 20^{o}C (Gills and Penny, 1977), while, *Pseudomonas fluorescence* can penetrate meat after 5-24-36 hours when was stored at 37-30-20^{o}C consecutively.

Humidity: Humidity is one of the main factors that affect the growth and proliferation of microorganisms especially on the surface of meat because the meat content of water influence the contamination of meat by organisms. Adherence process cannot be successful without high humidity at storage. Therefore, the penetrability of bacteria cannot occur without the availability of high humidity during the storage. Meat stored by cooling is usually surrounded with a high level of humidity which exceeded 90%, in addition to the water existed within the meat (Aboud, 2000). Water content within meat equal to 99% is suitable for the growth and proliferation of bacterial contaminants which cannot live if water content in meat is less than 90%. High humidity is important for bacterial penetration of meat (Nickerson and Sinky, 1997). Following penetration, the microorganisms will start to proliferate inside the meat made possible with suitable humidity when water was released after the death of animal and when muscles turned into meat other than water from cooling (Chizzolini *et al*. 1993).

Hydrogen ion concentration (pH): Most suitable pH for bacterial growth is close to 7.0 while for fungi and Candida requires a more acidic condition. Fungi can grow at pH 4-8 and Candida at pH 4-4.5. After slaughter, the pH of meat is more or less neutral and two hours later the pH will start to change to acidic. The pH of meat 2 hours after slaughtering is 9.0 and become 6.0 after 24 hours. This pH will maintain until 96 hours and then started to increase due to protein putrefaction. In fact when the value of pH decreased in meat to up to a 5% or less, bacterial growth remarkably decline in comparison with the ordinary pH of meat. On the other hand, when the pH of meat is high in the normal natural standard situation, will promote the optimal conditions for microbial growth even at high sanitary environment under utmost good management circumstances (Hoffman, 1972). The pH in meat can prevent or facilitate the growth and adherence of microorganisms or penetrability into meat tissue. However, studies have yet to ascertain this relationship.

Oxidation-Reduction reaction (O/R): This is defined as being the state of easy lost of electron by a material. Immediately after death, the body temperature and pH are merely equal to neutral, and meat spoilage is expected due to the growth of saprophytic bacteria. This phenomenon did not attribute to oxidation reduction reaction (O/R) because the reaction is maintained few hours after death. Fast changes in the (O/R) value and its affect can occur due to oxygen consumption through meat enzymes activities. The effect of oxidation reaction on bacterial growth is by extension of lag phase but the speed of growth is not remarkably influenced because of the adaptive mechanism to the value of oxidation reaction which in turn brings the low bacterial growth. The O/R in meat is not due to reduction of oxygen only; there are other compounds which also play a role. The value of O/R in hard meat is -200mv while in minced meat is +200mv (Jay, 1978).The value of O/R before rigor mortis in comparison to its value after few hours of death or after the complete process of rigor mortis differ as this affects saprophytic bacteria survivability (Barnes and Ingram, 1956). Experiment on equine meat showed that O/R value reach -130mv after 30 hours of animal death. According to these scientific facts, it is believed that the O/R value play important role in the speed of metabolism, growth and proliferation of bacteria that contaminate the meat and influence the penetrability of meat by direct or indirect means.

Size of cut meat piece: The surface area of meat exposed to environment can imply an effect on the storage value of meat. The amount of surface exposed area of meat is of immense influence on the value of stored meat. The increase in the exposed meat surface area is proportional to the increase in number of bacterial growth on meat surfaces. Accordingly, the minced meat is more vulnerable to spoilage due to large surface area and distribution of bacteria between the small pieces of meat. In this respect, the compact large meat pieces is less vulnerable to spoilage because of large surface area that are exposed to pollutant bacteria which lead to less number of bacterial pathogens on the limited area and also because of the dryness of the surface of large pieces and covered by fat layer that usually considered a natural barrier (Al-Delaimy and Stiles, 1975). It is advised to store meat as large pieces that make the penetration process of bacteria slow in meat. Bacterial penetration of meat is fast when meat is prepared as thin slices (Elmossalami and Wassf, 1971).

Type of meat: Animal's meat differs according to animal type, age, breed, sex and nutrition (Alaswad, 1989). The livestock meats consist of thick, compact muscle fibres, while sheep (mutton) meat consists of thin muscle fibres in comparison to livestock. This difference is due to the myofibrils diameter (50.4 μm in sheep, 73.3 μm in livestock). Animals' meat varies in the content of nutrients and their calories due to variations in the fundamental compounds (components) like protein, water, fat and metals in cattle which are 16.2-11.5, 89-55, 28-1, and 1.0-0.8 respectively. While in sheep the composition of these compounds are 18.6-12.8, 65-48, 37-16, 0.9-0.8 respectively (Lawrie, 1979). There is no clear evidence the type of meat effect bacterial penetration process, but scientists should expect that.

Fatty tissue: It's a type of loose connective tissue with gradual colour intensity varies from bright white to pale yellow or dull yellow (Altae, 1986). The type of fat in tissue depends on the type of fatty acids (saturated and non- saturated) of animal species. Cattle and sheep fat is hard while equine fat is very lean (Abood, 2000). Fat in meat can assist in increasing the nutritive value due to the content of amino acids. The fatty elements play vital role in metabolic processes especially the fundamental fatty acids, cholesterol, phospholipids and soluble vitamins. Fat is also important to give a better taste for meat industrial products. Meat fat is described as saturated type because it contain a 50-60% of saturated fatty acid like oleic acid and 3-10% non-saturated fatty acids of various bonds like linoleic acid, liolenic acid and arachidonic acid. The digestion index of animal fat in the human body could reach 96% (Eskin *et al.* 1971). Fats of different animal sources vary in consistency and hardness. Increase in the non-saturated fatty acid will cause leanness of meat and the cause of its fast spoilage. Many microorganisms are capable to produce lipolytic enzymes like lipase causing water degradation or oxidation of fatty acids. Enzymes will cause lysis of fat to glycerol and fatty acids. Phospholipids lysis produces nitrogenous base and phosphor (Gyles and Thoen, 1986). Fat play important roles in meat storage because it can preserve the meat in good quality. Although fat represent a sort of natural surface protection for meat because of its ability to impede the exit of microorganisms to the meat directly, at the same time can facilitate meat spoilage and limit the storage period when exposed to oxidation or chemicals.

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