COMPARISON OF BEEF AND MUTTON FATS IN RELATION TO FAT EXTRACTION YIELD, MELTING POINT, IODINE VALUE AND VISCOSITY

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THESIS DECLARATION

I hereby declare that the work embodied in this report entitled "Comparison of Beef and Mutton Fats in Relation to Fat Extraction Yield, Melting Point, Iodine Value and Viscosity" is the result of the original research and has not been submitted for a higher degree to any universities or institutions.

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I certify that this thesis entitled "Comparison Of Beef And Mutton Fats In Relation To Fat Extraction Yield, Melting Point, Iodine Value And Viscosity" by Muhammad Abdillah Bin Abdul Shukor has been examined and all the correction recommended by examiners have been done for degree of Bachelor of Applied Science (Animal Husbandry) with Honours, Faculty of Agro-Based Industry, Universiti Malaysia Kelantan.

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LIST OF ABBREVIATIONS

CLA	Conjugated linoleic acid
HDL	High density lipoprotein
I_2	Iodine
IBr	Iodine monobromide
LA	Linoleic acid
LNO	Linolenic acid
LDL	Low density lipoprotein
MUFA	Monounsaturated fatty acid
NaOH	Sodium Hydroxide
$Na_2S_2O_3$	Sodium thiosulphate
PPAR	Peroxisome proliferator-activated receptor
PUFA	Polyunsaturated fatty acid
SFA	Saturated fatty acid

LIST OF SYMBOLS

%	Percentage
ºC	Degree celcius
±	Plus-minus sign
g	Gram
g/mol	Grams Per Mol
h	Hours
mL	Milliliters
mg/L	Milligram per liter
min	Minutes
Pa.s	Pascal-second

COMPARISON OF BEEF AND MUTTON FATS IN RELATION TO FAT EXTRACTION YIELD, MELTING POINT, IODINE VALUE AND VISCOSITY

ABSTRACT

Animals are slaughtered to produce their by-products which can be well utilized for various applications in day to day human life, thus, contributing to the value of animals. Animal fats play an important role in a balanced diet and in the manufacture of food products contributing to texture and palatability. They are a valuable source of concentrated energy and essential fatty acids needed for growth and development. Animal lipids structural and storage, the structural lipids mainly phosphoglycerides, constitute between 0.5 and 1% of muscle and adipose tissue. Lipids are the major form of energy storage, mainly as fat, which may constitute up to 97% of the adipose tissue of obese animals. Fats were produced by a variety of processes, generally referred to as rendering. Fatty tissues from both beef and mutton are composed of essentially three components, viz. water, protein and fat. This study focused on chemical composition of mutton fat and beef fat involving determination of iodine value, origin of fat samples by melting point method and viscosity of fat samples. The fat yield of the fat was determined after the wet rendering process. The difference in the fat recovery rates in the different studies was probably because of the different animal meat abdominal fat tissues. Iodine value was recognised to indicate the amount of unsaturated fatty acid. Determination of origin of fat samples by melting point method was focused on the fats melt at different temperatures, mainly due to their fatty acid characteristics. For viscosity, both length and saturation of fatty acids affect the arrangement of the membrane. Shorter chain fatty acids and ones with greater unsaturation are less stiff and less viscous, making the membranes more flexible.

PERBANDINGAN DI ANTARA LEMAK LEMBU DAN LEMAK KAMBING DARI SEGI HASIL PENGURAIAN LEMAK, TAKAT LEBUR, NILAI IODIN DAN KELIKATAN LEMAK.

ABSTRAK

Haiwan disembelih untuk menghasilkan produk sampingan yang boleh digunakan dengan baik untuk pelbagai aplikasi dalam kehidupan seharian, oleh itu, menyumbang kepada nilai haiwan. Lemak haiwan memainkan peranan penting dalam diet yang seimbang dan dalam pembuatan produk makanan yang menyumbang kepada tekstur dan kesesuaian. Mereka adalah sumber berharga dari tenaga pekat dan asid lemak penting yang diperlukan untuk pertumbuhan dan pembangunan. Lemak haiwan struktur dan penyimpanan, lemak struktur terutamanya phosphoglycerides, membentuk antara 0.5 dan 1% daripada otot dan tisu adipose. Lipid adalah bentuk utama penyimpanan tenaga, terutamanya sebagai lemak, yang boleh membentuk sehingga 97% daripada tisu adipose haiwan. Lemak dihasilkan oleh pelbagai proses, secara amnya dirujuk sebagai rebusan. Tisu lemak dari kedua-dua daging lembu dan kambing terdiri daripada tiga komponen utama, iaitu. air, protein dan lemak. Kajian ini menumpukan pada komposisi kimia lemak kambing dan lemak daging yang melibatkan penentuan nilai iodin, asal sampel lemak dengan kaedah lebur dan kelikatan sampel lemak. Hasil lemak lemak ditentukan setelah proses penyajian basah. Perbezaan dalam kadar pemulihan lemak dalam kajian yang berbeza mungkin disebabkan oleh daging haiwan yang berbeza daripada tisu lemak perut. Nilai iodin diiktiraf untuk menunjukkan jumlah asid lemak tak tepu. Penentuan asal sampel lemak dengan kaedah lebur titik difokuskan pada lemak meleleh pada suhu yang berbeza, terutamanya disebabkan oleh ciri-ciri asid lemak mereka. Untuk kelikatan, kedua-dua panjang dan tepu asid lemak mempengaruhi susunan membran. Asid lemak rantai yang lebih pendek dan yang tidak terkawal dan kurang likat, menjadikan membran lebih fleksibel.

CHAPTER 1

INTRODUCTION

1.1 Research Background

Animal fats are rendered tissue fat that can be acquired from different types of animal. At the point when animal are slaughtered to deliver meat for human utilisation, roughly 50% of the animal is turned into animal by-products (Giriprasad & Goswami, 2013). Lipids entered in the organization of living tissue from the specific beginnings of life on Earth. It is perceived that life showed up on Earth around 37 million years prior, being made from microbes single-cell life forms, kind of life that commanded the planet more than one billion years.

These early types of lipids have advanced with animal and plant species prompting diverse types of creature and vegetable fats, utilised by individuals in antiquated occasion. Animal fats play an important role in a balanced diet and in the manufacture of food products contributing to texture and palatability. They are some valuable sources of concentrated energy and essential fatty acids needed for growth and development. In fact, lard has been suggested as an excellent alternative to cows milk fat in infant formulae due to its closer fatty acids profile to breast milk (Brooke, 1985) and lard is easily absorbed and digested (Beenion et al., 1966). One may not think of fats as being essential, but they are. Although fats are needed in small amounts they are a necessary part of the diet. Fats provide energy and store excess energy. Fats help to

produce body heat and carry fat-soluble vitamins in the body. Many sources of proteins are also sources of fats. Fats were found in both plants and animals (Soetan, 2005).

Animal fats are naturally occurring as chemical compounds in the bodies of animals, which act as storage for energy and structural support and thermal insulation. Lipids play an important role in storing energy. If an animal eats an excessive amount of energy it is able to store the energy for later use in fat molecules. Fat molecules can store a very high amount of energy for their size which is important for animals because of our mobile life styles.

The largest difference between vegetable oils and animal fats is the amount of saturated and unsaturated compounds in them. Render Magazine (2009) indicated that when chemical properties of various feedstock materials for biodiesel production are compared, the main difference between vegetable oils like rapeseed oil and animal fats can be found in the diverse fatty acid composition.

Lipids are generally represent in animal tissues, having in living life forms in particularly vitality role. They can be considered as the fundamental type of vitality stockpiling. Additionally, they meet plastic role since they enter in the structure of cell segments and also as defensive barrier. In numerous nations, fat is a disliked constituent of meat for consumers, being viewed as unhealthy. However, fat and fatty acid whether in fat tissue or muscle, contribute essentially to different parts of meat quality and are vital to the nutritional value of meat (Wood et al., 2008).

People have eaten animal fats for centuries, fulfilling the body's interest for fundamental supplements. They are a characteristic and useful part of a decent eating routine, providing vitality and nutrients. Edible animal fats additionally empower the utilisation of critical supplements inside the body. For instance, nutrients A, D, E and K

are not just found in edible animal fats yet require fat to be transported and utilised by the human body. Furthermore, all animal fats contain huge levels of oleic acid. This is the high fatty acid found in olive oil and is believed to be mindful for the medical advantages related with its utilisation. Poultry fat and lard specifically contain abnormal amounts of oleic acid.

The history of rendering can be approached from different angles. Since Roman times the art of soap making from ash and rendered fat has been well known. Other applications for animal fats, such as candle making from cattle and sheep tallow, came later. In the middle of the 19th century the rendering process became industrial as well. The word "Rendering" is an old word which can mean different things to different people. In its simplest form, Rendering means "to Render open" (or split) – by heat processing – raw material into a solid (protein meal) and a liquid (fat is a liquid at elevated temperatures).

While in theory this would cover all aspects of animal by-product processing, the practical word Rendering has in many cases become synonymous with the processing of inedible animal by-products. However Rendering also describes the processing of edible grade by-products and in these circumstances Edible Rendering should be clearly stated, although many still prefer to use the term "fat processing". There are two main systems of rendering, described as either wet or dry systems, with the latter being further divided into natural fat and added fat systems. However, this is still rather an over simplification and in reality many types of processes are in existence through the world, and many have been altered and adapted in accordance with technical advances and legislative changes over the years (Woodgate & van der Veen, 2004).

In comparison to other meats available on the market, goat fat has advantages such as low fat, high digestibility, high protein, iron and unsaturated fatty acid amounts (Madruga, 2004). Although consumption of goat fat varies according to the demands of the societies, consumer demands are more often in search of low-fat, low-calorie, healthy and a new fat sources. Previous studies have shown that consumers' perception on fat healthiness is related to its fat content and fatty acid composition (Kai, 2014). Goat fat is considered lean and contains more polyunsaturated fatty acids in comparison with fat from other ruminants. Different nutritional conditions may alter fatty acid composition in the muscles of ruminants. Lipid supplementation, in addition to promoting higher weight gain and better carcass composition due to the higher energetic density has been credited as one of the main factors to increase concentration of mono and polyunsaturated fatty acids (Maia et al., 2012).

1.2 Problem Statement

Despite several issues in relation to human health, beef is still a most popular meat product among large section of society due to the presence of high quality protein and other nutrients. Presence of high level of lipids in beef has been a topic of discussion for beef consumers because of their associated health implications. In general lipid fraction in beef varies from 4-15% on fresh basis depending on several factors including genotype, feeding regime and meat cut. Fats are a touchy and controversial subject. On one hand, they provide the immediate satisfaction of taste on food and nutrition and give food items the desired look and consistency. On another, the general public belief is that more fat consumption directly correlates to more body fat accumulation. Most of the studies on animal fat over the recent year have been on quantitative and qualitative

analyses, involving determination of iodine value, acidic value, saponification value and fatty acid profile. There have only been a few studies to understand the phase change behaviour on mutton fat and beef fat.

1.3 Objectives

In order to study the chemical composition of mutton fat and beef fat, the objectives of this research are as follows:

1. To study origin of different fat samples exhibit different melting points.
2. To determine the iodine value of fats indicates a degree of unsaturation fatty acids.
3. To compare the viscosity of fat samples.

1.4 Scope of Study

This study focuses on the chemical characterisation of mutton fat and beef fat from different chemical analyses by wet rendering process, iodine value, determination of origin of fat samples by melting point method and viscosity of fat. The fat yield of the fat was determined after the wet rendering process. Iodine value is recognised to indicate the amount of unsaturated fatty acid. The higher the iodine value, the lower becomes the melting point. Determination of origin of fat samples by melting point method is focused on the fats melt at different temperatures, mainly due to their fatty acid characteristics. For viscosity, both length and saturation of fatty acids affect the arrangement of the membrane. Shorter chain fatty acids and ones with greater unsaturation are less stiff and less viscous, making the membranes more flexible.

1.5 Significance of Study

This study focused on chemical composition of mutton fat and beef fat involving determination of iodine value, origin of fat samples by melting point method and viscosity of fat samples. This study was carried out to understand in making comparison between mutton fat and beef fat by using different chemical analysis.

1.6 Limitation of Study

In this study, there were few limitation with regards to chemical set up. Preparation of Hanus iodine could take long time in 7-8 hours process. Analysis of determination iodine value from fat samples was done by Hanus method which is the method for determining the iodine value of oil or fat that consist the addition a mixture of iodine and bromine in glacial acetic acid. Besides that, it also estimates the excess of unused halogen by titration with sodium thiosulfate.

CHAPTER 2

LITERATURE REVIEW

This chapter contains a short summary of information available in literature concerning the possible application of animal fat.

2.1 Animal Fats

Different species of animals produce animal fats. Animal fats are rendered tissue fats (Sharma, Giriprasad & Goswami, 2013). Basically, these are the by-products of the meat packing industry, made available as a result of the preparation of meat either for sale as meat percent or from the manufacture of meat product (Sharma, Giriprasad & Goswami, 2013). Fat is a term to describe the class of macronutrients that used in metabolism called triglycerides that provide energy and also act as food source. Fats are the most prevalent class of compounds referred to as lipids. Triglycerides consist of a glycerol backbone that bond to three fatty acid chain via an ester bond. The chain of fatty acid is elongated on a single fatty acid synthase until it reaches a length by biochemistry of its producer.

2.1.1 Mutton Fat

The proportions of muscle, fat and bone in a mutton carcass are the chief factors that determine its value. In outward appearance, the carcass should convey the impression of being a solid block of meat with fat distributed evenly over the body. A carcass short in the leg, broad as seen from the top, back and front, long in the body, with a sufficient covering of fat, commands the highest 'price. The hindquarters should have meat bulging on all sides of the leg down to the hock joint, where a sharp inward curve narrows the leg down to continue on a short light shank. Fat measurements stand at an almost fixed figure, irrespective of muscle, bone and weight changes. More than a certain thickness of fat is wasteful as it is removed from a joint either before being sold or at the table. On the other hand a joint with too little fat appears unfinished, unattractive and allows the juices to escape during cooking, resulting in a drying and loss of succulence.

Fat, especially that on the back and ribs, is the most important factor in determining the quality of a carcass. Thickness of fat over the spine does not affect carcass quality. The depth of eye-muscle is more important than the length. A well muscled rib is favoured. Long bone is detrimental to quality. Fat has the greatest influence on weight, with muscle next and bone least. Most fat is added on the ribs, especially at 21 months.

2.1.2 Beef Fat

Quality in beef is affected by more factors than quality in mutton. "Carcass proportions (muscle, fat and bone) are of chief importance in selling mutton, but other equally important factors influence beef quality. A beef carcass may be described in terms of conformation, finish and quality of meat. Best conformation involves short

shanks and neck, deep and plump rounds, thick full loins and a relatively thick flank. Correct finish implies a smooth, sufficiently deep covering of firm white fat evenly distributed over most of the exterior surface of the carcass. Quality of the meat refers primarily to the structure of the meat, that is the size of muscle fibres and muscle bundles (texture), the amount and distribution of connective tissue per unit volume of meat, the amount and distribution of intramuscular fat (marbling), and the nature of the meat juices or extractives. These quality factors are closely associated with the tenderness and palatability of meat and, although of greater importance in beef than in mutton, are applicable to the latter in principle.

2.2 Characteristics of Fat

Fats and oils make up of one of the three major classes of foods and the others being carbohydrates and proteins (Sharma, Giriprasad & Goswami, 2013). Chemically, they may be termed as esters of three carbon carboxylic trihydroxy alcohol, glycerol (propan-1,2,3-triol), and various monocarboxylic acids known as fatty acids (Sharma, Giriprasad & Goswami, 2013). As glycerol is a trihydroxy alcohol, monoacid, diacid and triacid esters are known (Sharma, Giriprasad & Goswami, 2013). Fats and oils are the mixtures of triglycerides. Triglycerides are made up of three fatty acids linked to glycerol by fatty acyl esters. Fatty acids are long chain hydrocarbons with carboxyl groups (COOH groups). These fatty acids can be classified into saturated or unsaturated based on the number of double bonds present in the fatty acid.

Saturated fatty acids contain only single bond between the carbon atoms and are tend to be solids at room temperature. Unsaturated fatty acids contain double bonds between the carbon atoms in addition to the single bonds present in the fatty acid chain.

They are likely to exist as liquids at room temperature. The double bonds present in the naturally occurring unsaturated fats are in the Cis form. There are different methods for checking the unsaturation level in fatty acids, one among them is by determining the iodine value of fats. A higher iodine value indicates high degree of unsaturation (Amrita, 2011). The lipids are a group of substances found in plant and animal tissues. They are insoluble in water but soluble in common organic solvents such as benzene, ether and chloroform. They act as electron carriers as substrate carriers in enzymic reactions, as components of biological membranes and as sources and stores of energy. In proximate analysis of foods they are included in the ether extract fraction.

Animal lipids structural and storage, the structural lipids mainly phosphoglycerides, constitute between 0.5 and 1% of muscle and adipose tissue. Lipids are the major form of energy storage, mainly as fat, which may constitute up to 97% of the adipose tissue of obese animals. The concentration in the liver is usually between 2 and 3%. The yield of energy from the complete oxidation of fat is about 39MJ/kg DM compared with about 17MJ/kg DM from glycogen, the major carbohydrate form of stored energy. The most important non-glyceride, neutral lipid fraction of animal tissue is made up of cholesterol and its ester, which together make up 0.06 to 0.09% of muscle and adipose tissue. Stored fat is almost anhydrous, whereas stored glycogen is highly hydrated. Weight for weight, fat is, therefore about six times as effective as glycogen as a stored energy source.

2.2.1 Saturated and Unsaturated Fatty Acid

Saturated fatty acids contain only single bond between the carbon atoms and are tend to be solids at room temperature. Each carbon atom in the chain holds all the possible hydrogen atoms it can. These are also the sort of lipid found around organs in the human body, acting as cushions to protect internal organs (Carman, 2007). Saturated fats are mostly solid at room temperature, including butter, the tropical oils (coconut oil, palm kernel oil, palm oil, rice bran oil), lard, and other animal fats. Animal fats are "fats in the food supply that are obtained from animal sources include beef tallow and butterfat (milk fat) from cattle and lard from pigs" (McWilliams, 2008). The only plant fats that are mostly saturated are the tropical oils, which are even more saturated than animal fats. Chemically, saturated fats are fatty acids in which all available carbon binding sites are saturated with hydrogen, therefore giving them the name "saturated" fats.

Unsaturated fatty acids contain double bond between the carbons atoms in addition to the single bond present in the fatty acid chain. These fatty acids tend to be liquid at room temperature and are the primary type of lipid found in skin deposits. Naturally occurring unsaturated fatty acids contain double bonds that are in the 'Cis' form and artificial unsaturated fatty acid double bonds that are in the 'Trans' form. The trans-fatty acids are found in margarine and have a high link with heart disease.

Unsaturated fatty acids can be converted into saturated by the process of hydrogenation. Depending upon the degree of unsaturation, the fatty acids can combine with oxygen or halogens to for saturated fatty acids (Amrita, 2015). So, it is important to know the extent to which a fatty acid is unsaturated. There are different methods for checking the unsaturation level in fatty acid, one among them is by determining the

iodine value of fats. Iodine value or number is the number of grams of iodine consumed by 100g of fat. A higher iodine value indicates a higher degree of unsaturation.

For trans fatty acids, Double bonds are found in 2 different configurations: cis and trans forms. If the substituents are on the same side, cis form occurs. When the substituents are in different side, trans form occurs. The hydrogenization period is accelerated and occurrence of trans fatty acids increases when fats are fried for long time (7-8 hours) in high temperatures (over 185 °C). The studies regarding trans unsaturated fatty acids exhibit that side effects are occurred in case of over consumption. Unsaturated trans fatty acids could be more harmful than saturated fatty acids.

Essential fatty acids, Linoleic acid (LA) and linolenic acid (LNO) from the PUFA series are the essential fatty acids for the animal nutrient requirements. The most common of PUFAs is LA, the richest source for LNA are the cold water fish. There is an enzymatic competition for synthesis of poly-unsaturated fatty acids from LA and LNA in the body. Due to this reason, the rate of LA and LNA should be 1-4:1 in diet. Arachydonic acid which is known as essential fatty acid, could be synthesized from LA. The fatty acids acquired from aromatic plants are also defined as essential fatty acids for plants, while the oil acquired from aromatic plants have important usage efficiency with its antioxidant, antibacterial, anti inflammatory, insecticide, antispasmodic, expectorant, fungicide and antivirutic.

2.2.2 Fat Quality

The quality of fat, from meat animals, is defined as being firm and white in pigs and firm and creamy-white in cattle and sheep (Wood, 1984). This definition is derived from butchery and cooking manuals, where poor quality fat is described as being oily, soft, wet, gray and floppy. Meat products containing soft fat can show quality defects such as rancidity development due to lipid oxidation, insufficient drying and inferior fat consistency (Hugo & Roodt, 2007). Fat is composed of approximately 84 percent lipids, 14 percent water and 2 percent collagen, where lipids are the major contributor to consistency (Wood et al., 1989). Whether a fat or oil material is soft or hard is determined by the fatty acids composition (Wood, 1984; Warriss, 2000; Hugo & Roodt, 2007). Plant oils which are liquid at room temperature consist mainly of unsaturated fatty acids whereas fat from animals is often solid at room temperature due to a significant higher amount of saturated fatty acids (Warriss, 2000). Fat quality is therefore most often measured by the level of saturation, either by determining the amount of iodine (iodine number) (Warriss, 2000) or by gas cromatographic analysis (determines the fatty acid composition) (Hugo & Roodt, 2007). Also physical properties such as melting point and colour can be measured (Hugo & Roodt, 2007).

The yellow colour of fat is due to the carotinoid pigments. Fat from cattle and horses contains chiefly carotin, yellow fat from rabbits and poultry chiefly xanthophyll; the almost white fat of sheep and goats contains a meagre amount of carotin, and pig fat is altogether unpigmented. The effect of condition on the colour of fat is largely dependent upon the amount of pigments the animal has ingested in the course of fattening, and whether, during that time, there was any fall in condition. No difference in the colour of fat between steers and heifers has been found. Fat bleaches by oxidation although it is not known how rapidly this occurs in beef fat.

The process is accelerated by "shrouding", e.g. pinning hot damp cloths tightly over the carcase after killing. Beef fat retains an appreciable amount of blood haemoglobin in the capillaries even after bleeding. This gives the fat a pinkish tinge and when the haemoglobin changes to methaemoglobin it gives the fat a brown, or dead, chalky appearance, according to the amount of haemoglobin originally present. These discoloured patches are most frequent where carcases have chafed in transport, keeping the fat surface moist, a condition conducive to methaemoglobin formation. In meat animals the firmest fat is found in sheep, followed by cattle, and the softest in pigs. Soft fat is a serious problem in the latter only. The effect of age on the firmness of fat has not been sharply dissociated from the possible effect of condition. It is claimed that fattening decreased the firmness of beef fat. This probably depends on the nature of the fattening ration, but just how feed may influence firmness in beef fat is unknown. Exercise has no effect on firmness; steer and heifer beef show no difference.

Marbling is of great importance in beef, for the interspersion of fat between muscle bundles and fibres gives beef a tenderness, juiciness and flavour that is lacking without marbling. Greater tenderness is probably due to the breaking up of the connective tissue by the fat deposited in it. The distribution of marbling fat and show that in well finished carcases the later maturing parts such as the loin and ribs (the most expensive cuts) are best marbled.

2.2.3 Classes of Dietary Fats

Dietary fats are the important components of a nutritionally balanced diet. Besides adding flavor, appetite appeal and satiety to foods, fats provide essential fatty acids and aid in the absorption of fat-soluble vitamins A, D, E, and K and carotenoids. In addition, fats are a concentrated source of energy, providing 9 calories per gram compared to 4 calories per gram for protein and carbohydrates. Dietary fat consists primarily of triglycerides with smaller amounts of phospholipids and sterols. Because triglycerides and phospholipids are comprised primarily of fatty acids attached to a glycerol molecule, the overall fatty acid profile and composition is the focus of any discussion about lipids in meat such as beef.

All fats and oils from animal and vegetable sources contain mixtures of both saturated and unsaturated fatty acids. Saturated fatty acids (SFAs) contain only single carbon-to-carbon bonds, are quite stable, and are the least reactive chemically. Unsaturated fatty acids contain one (monounsaturated fatty acids [MUFAs]) or more (polyunsaturated fatty acids [PUFAs]) carbon-to-carbon double bonds in the cis configuration. The chemical reactivity increases as the number of double bonds increase. Trans-fatty acids are unsaturated fatty acids that contain at least one double bond in the trans configuration. The ratio of SFAs, MUFAs, and PUFAs and the position of specific fatty acids on the glycerol molecule of the triglyceride contribute to specific physical and physiological properties of fats and oils.

In general, animal fats contain larger amounts of SFAs and are solid at room temperature; plant fats (oils) have a higher content of unsaturated fatty acids and are liquid at room temperature. Conjugated linoleic acid (CLA), a trans-fatty acid found in beef, is a collective term for a group of geometric and positional isomers of linoleic acid, an essential fatty acid. All fatty acids, regardless of the type (saturated or unsaturated) provide the same number of calories per gram when metabolized for energy.

2.3 Function of Fats

Harry (1995) said that fat provide tenderness, structural integrity, aid in the incorporation of air, and to extend shelf life of food. Fats are very importance and usefull in production of confectionaries and also as emulsifiers in food products. According to Shahidi, 2004 say that the short and medium chain-length of dietary fatty acid are not usually esterified but it rapidly oxidized that will become the source of can be call fuel in tissues that to support all the events necessary and keep functioning organisms to work.

Futhermore, fatty acids that have long-chain are usually esterified to glycerols in tissues (Shahidi, 2004). This is importance and funtioning for growth, building cell walls and aid in the construction of phospholipids. Essential fatty acids shoud be obtained therefore, fatty acids cannot be synthesised by the body and it good for the diet. They aid in lowering excessive cholesterol levels in the body, thereby decreasing the occurrence of cardiovascular diseases. According to Maxwell and Marmer (1983), fatty acids are also can be used as biosynthetic precursors of many insect pheromones and secondary metabolites in plants Unesterified fatty acids are produced rapidly as a

consequence of the binding of specific agonists to plasma membrane receptors which is it can enable to act as second messengers required for the translation of external signals. Fatty acids can act to amplify or otherwise modify signals within cell that influence the process and activities of enzymes such as protein kinases, phospholipases, and many more.

There are other uses and functions of animal fat. They are involved in regulating gene expression, mainly targeting genes that encode proteins with roles in fatty acid transport or metabolism via effects on transcription factors, i.e., peroxisome proliferator-activated receptors (PPARs) in the nuclei of cells. Such effects can be highly specific to particular fatty acids (Hui, 2006). Thus, unesterified arachidonic acid may have some biological importance as part of the mechanism by which apoptosis (programmed cell death) is regulated. Stores of fat within the human body are important as they provide quick access to energy while fasting, act as insulation from hypothermia, while fat surrounding organs provides an internal layer of protective padding (Shahidi, 2004).

The ingestion of fats however, must be done with moderation. It has been found that saturated fats are major causes of cardiovascular disease such as arthelesclerosis (Gunstone, 2004). They increase low density lipoprotein (LDL) cholesterol, the so called “bad” cholesterol, which leads to coronary heart disease. Trans fats, introduced during partial hydrogenation causes and increase in LDL cholesterol while concurrently decreasing HDL cholesterol (Gunstone, 2004).

2.4 Iodine Value of Animal Fats

Iodine value, also called Iodine number, in analytical chemistry, is the measure of the degree of unsaturation of the fat which is the amount of iodine, in grams, absorbed by 100 grams of fats (Encyclopedia Britannica, 2001). Saturated fats take up no iodine, therefore their iodine value is zero; but unsaturated oils, fats, and waxes take up iodine, therefore they have iodine value (Encyclopedia, 2001). This is because unsaturated compounds contain molecules with double or triple bonds, which are very reactive toward iodine (Encyclopedia, 2001). The more iodine is attached, the higher is the iodine value, and the more reactive, less stable, softer, and more susceptible to oxidation and rancidification is the fat (Encyclopedia, 2001).

Generally, a known excess of iodine, usually in the form of iodine monochloride, is allowed to react with a known weight of the fat to perform the test and then the amount of iodine remaining unreacted will be determine by titration with standard sodium thiosulphate solution (Encyclopedia, 2001). The higher the iodine value, the lower the melting point will become (Sharma, Giriprasad & Goswami, 2013). Iodine undergoes addition reaction with fatty acids at the position of double bonds between carbon atoms. The amount of iodine that reacts with beef fat and chicken fat related to the number of unsaturated bond in fat.

Beef fat sample and mutton fat sample have different iodine value due to their presence of degree of unsaturation of a fat. In general, red meats (beef, pork and lamb) have more saturated (bad) fat than chicken, fish and vegetable proteins such as beans. Saturated and trans fats can raise your blood cholesterol and make heart disease worse. Poultry has low levels of polyunsaturated fatty acids (PUFA), including the long chain (C20-22) PUFA in adipose tissue and muscle (Wood JD, 2008). It contains the lowest

iodine value compared to the chicken fat and beef fat. Therefore, by knowing the iodine value, we can easily differentiate the origin of fats sample.

2.5 Determination of Origin of Fat Samples by Melting Point Method.

In determining the origin of sample of fat, by using melting point , it is important to understand that melting point can be grouped in different ways . In this experiment, beef and chicken sample were used. For fats, triglycerides are the main component. Three different fatty acids will form triglycerides. Fat also contain mono and diglycerides, phosphatides, fat-soluble vitamins, pigments and other and other substance. Beef fat sample and mutton fat sample formed from different melting point. Melting point was defined as the temperature in which a given solid will melt.

There are two general categories of animal fats which is edible fat and also inedible fat. Not all edible fats are used in human consumption because certain qualities are needed in feed, pet food and olechemical induatry. On the other hand inedible are not allowed in human consumption (Alm, 2011).

Each fat sample has different length of fatty acid chain and percent of saturated and unsaturated fat contained. Saturated fats that rich in long-chain fatty acids are less digestable than fat that high in medium – chain fatty acids or unsaturated fatty acids. Saturated fat also usually known as animal fat as most of animal fat are saturated compared to unsaturated fat. Melting points method used in the experiment to determine origin of fat sample that track obesity to its source. Capillary tube provided to carry out the experiment together with two sample of fat which is beef fat and also chicken fat. Length of fatty acid for each fat are depends on melting point recorded in the experiment.

2.6 Utilisation of Animal Fats

Animal fats have been utilised in numerous ways and for various uses. Some of the traditional uses of rendered animal fats include in making candles by use of sheep or beef tallow. Beeswax can be added to the tallow to harden it and make the candles burn longer. Making soap by fat and lye (NaOH). Traditionally, lye was made by leaching water through wood ashes. Making dubbing to protect shoes and other leather goods. It is made of equal parts beef tallow, cod liver oil and beeswax. The ingredients are heated in a pot while stirring until melted, then allowed to cool and applied to leather with the hands. Cooking, animal fats are used in frying and to baste roasting meat.

However, recent linkages of high cholesterol levels in animal fats have reduced their usage in cooking due to relation to heart disease. Food preservation, rendered fat was often used to seal jars of pickles, potted meat or other preserved food. Melted fat was poured into the jar and as it cooled it formed a solid layer at the top of the jar which prevented air from getting to the food. Medicinal Uses, animal fats were used in ointments and salves for external use. Use in cold pressing of metal processing industry as a lubricant and for heat absorption.

Although animal fats are largely edible, there are also inedible sources of animal fats from diseased animals or part of meat production that have been deemed inedible. The use of animal fats has been traditionally for consumption purposes, although large scale utilization comes from the industrial purposes for soap making and to a smaller extent from the steel industry. The usage in cooking has been reduced due to the high cholesterol level in the animal fat and the solidification of fats at room temperature.

Besides, the fatty acid composition and the melting point of fat for feed applications are important features for the production of a high quality feed pellet and a good consistency of meat. The alternative use of vegetable fats with lower melting point results into the so-called “weak” meat, which is not acceptable for consumers. For animal fats the good nutritional aspects (e.g. linoleic acid), digestibility and high energy density are playing an important part to draw up a feed composition. Feeding animal fats have especially a positive influence on the meat quality and taste. Feed producers prefer animal fats on account of the positive effect on the crystallisation characteristics for calfmilk replacers and the formation of a firm pellet for compound feeds. A firm pellet leads to higher production capacities (up to 15%) and a higher feed performance. Better economics are also relevant in the case of feeding animal fats, i.e. lower feed costs, higher feed performance and higher return on animal by-products. The fatty acid composition of the fat used for feeding monogastric animals is of direct influence on the composition of the fat stored by the animal. Fats are especially stored under the skin and around specific organs, like kidneys. But also muscular tissue contains fat, inducing more tendered and tasteful meat (Petz, 2003).

Animal fats also play an important role in a balanced diet and in the manufacture of food products contributing to texture and palatability. They are a valuable source of concentrated energy and essential fatty acids needed for growth and development. In fact, lard has been suggested as an excellent alternative to cows milk fat in infant formulae due to its closer fatty acids profile to breast milk (Brooke, 2004) and lard is easily absorbed and digested.

CHAPTER 3

METHODOLOGY

3.1 Materials and Equipment

Table below shows the materials and equipment that were used.

Table 3.1: Materials and equipment used

Materials	Equipment	Chemicals and Reagents
Cow's fat	Hot plate	Hanus iodine solution
Mutton's fat	Electronic balance	Sodium thiosulphate
Beakers	Burette	Potassium iodide
Capillary tube	Pipette	
Measuring cylinder	Viscometer	
Iodine flask		

3.2 Fat Extraction Yield by Wet Rendering Process.

Raw material that had been used in this research to produce animal fats was from cow and goat fat. They were bought from local market in the town of Jeli, Kelantan, Malaysia. The cow meat is from frozen meat that have already package in weight of 1kg each. The frozen cow meat was choosen because it have the same volume, type and more easy to handle. Cow meat was chop to reduse it size into small pieces. This process occur to promotes good solvent contact as it provides a greater surface to volume ratio, enhances fat extraction resulting. By using wet rendering process, this is generally vertical type equipment in which steam directly comes in direct contact with raw material or charge. Approximately 1kg of mutton meat and beef meat is cooked at 100^{o}C for 1-2 hrs. After processing, the tankage or slush is allowed to settle for 30 min. These greasy or fatty material which floats on top is removed first, followed by water and finally by the tankage with digested meat and bones. Compare the percentage fat yield within the two sample.

$$percentage\ of\ fat\ yield(\%) = \frac{weight\ of\ fat}{weight\ of\ sample} \times 100 \qquad (3.1)$$

3.3 Determination of Origin of Fat Samples by Melting Point Method

The beef fat and mutton fat sample in beaker was melt on hot plates at temperature 60^{o}C and above. The clear liquid fat was obtained. The beef fat and goat fat was keeping in cool place and protect from light and air.

The melted beef fat and mutton fat sample was filled in two capillary tubes by dipping the capillary tubes in the melted beef fat and melted mutton fat sample. Then, to remove any fat adhering to the outer surface the tubes, the capillary tubes was wipe immediately with tissue. The capillary was closed by using plasticine to prevent the melt fats flowing out. Then, the filled capillary tubes was kept in the cooling bath for 3 minutes.

By using rubber band, the capillary tubes was attach to the thermometer, by the lower end of the capillary tube lie adjacent to the bulb of the thermometer. It is important to avoid transfer of the body heat to the capillary tube.

The temperature of the moment fat starts to melt which is initial reading and fully melt which is final reading in the each capillary tubes it was noted. The experiment was repeated three times for each fats sample and the arithmetic mean of two readings obtained was calculated. Then, the errors was calculated and compared.

3.4 Determination of Iodine Value of Beef Fat and Mutton Fat.

Fat sample were melted and dried by filtering using filter paper that have 2gm of anhydrous sodium sulphate sample. Then the fat sample which is mutton fat and beef fat sample were kept in oven at 100 degree celcius. After that, the samples were cooled to 68 degree celcius in desiccator.

Each fat sample then dropped into the iodine flask about 5 drops. The iodine flask that filled with beef fat sample and also mutton fat sample were added in 5ml of chloroform together with blank iodine flask. All two flasks were swirled to ensure that the sample was completely dissolved.

As the samples were completely dissolved, 15ml of Hanus Iodine were dispensed in all two iodine flask that filled with the samples. As soon as Hanus Iodine dispensed, the flask then immediately closed with the stopper and swirled them to mix the sample. Then all samples which is beef fat and mutton fat were stored in dark place for 30 minutes.

After 30 minutes, the samples were removed out of dark place and were dispensed of 7.5ml of potassium iodide solution for each flask. The flask then swirled for reaction occur in the sample. Then, 37.5ml of water were added into each flask to stop the reaction.

Those samples were poured into conical flask for titration. Each of the samples was titrate with 0.1M of sodium thiosulphate solution until the solution turn into pale yellow. The titration stopped for a while to add in 1ml of starch indicator. Then, titration process continued until the solution turns into pale pink or colourless.

Next, the iodine values for the two samples were calculated by using the formulae at below (G.N. Anyasor, et al, 2009).

$$\text{Iodine value (Wij's)} = \frac{(V_2 - V_1) \times 1.269}{\text{Weight of sample (g)}}$$

Where: V_2 = titer value for blank, V_1 = titer value for sample (s)

Figure 3.1: Iodine value formulae

3.5 Compare in Viscosity of Mutton Fat and Beef Fat using Viscometer.

Mutton fat and beef fat was heated using hot plate in 60^{o}C to get in melting form. Each of fat sample been cooled down in cold water in ranged 20^{o}C-30^{o}C. Each fat sample undergoes viscosity test by using viscometer. The experiment was repeated three times for each fats sample and the arithmetic mean of two readings obtained was calculated.

3.6 Statistical Analysis.

The data were presented as mean $\pm$ standard deviation.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Fat Extraction Yield using Wet Rendering Process.

Extraction of beef fat and mutton fat was conducted by using wet rendering processes. The difference in the fat recovery rates in the different studies was probably because of the different animal meat abdominal fat tissues. The same weight of samples was used to determine the percentage of fat yield (1kg each). The percentage of fat yields (g) of beef fat and mutton fat which were 5.75% and 1.68% respectively. Beef fat had the highest percentage of fat yield than mutton fat.

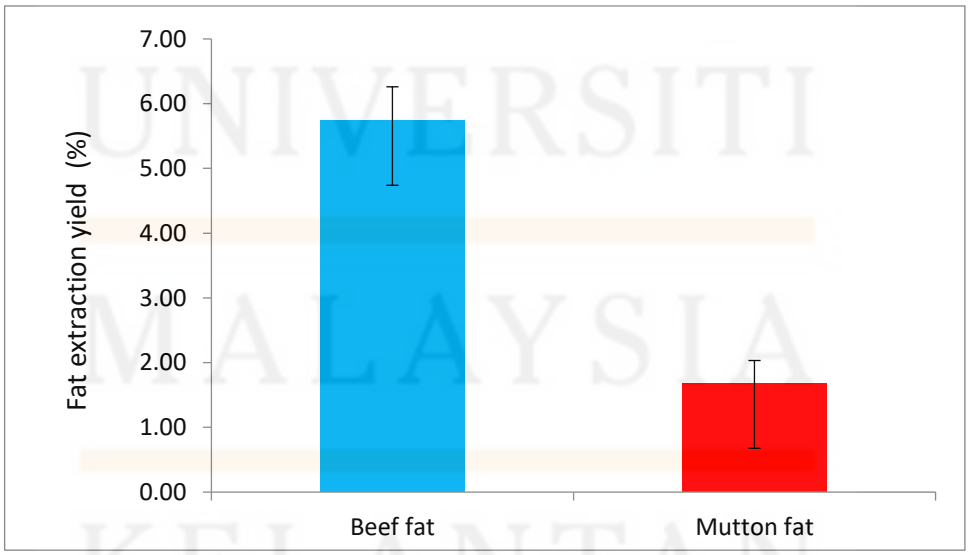

Figure 4.1: Fat extraction yield (%) of beef fat and mutton fat

4.2 Determination of Origin of Fat Samples by Melting Point Method.

Table 4.1 shows the melting point of beef fat and mutton fat while Table 4.2 shows the determination of origin of beef fat and mutton fat by melting point method.

Table 4.1: Melting point of beef fat and mutton fat

Type of animal fat	Temperature (˚C)				Average melting point	Standard Deviation
Mutton Fat	Initial reading	26 ˚C	26 ˚C	24 ˚C	25.33 ˚C	1.15
	Final reading	38 ˚C	39 ˚C	39 ˚C	38.67 ˚C	0.58
Beef Fat	Initial reading	27 ˚C	26 ˚C	24 ˚C	25.71 ˚C	1.52
	Final reading	46 ˚C	46 ˚C	41 ˚C	44.33 ˚C	2.89

Note: Initial temperature: Fats start to melt (melting point)

Final temperature: Fats fully melt (melting point)

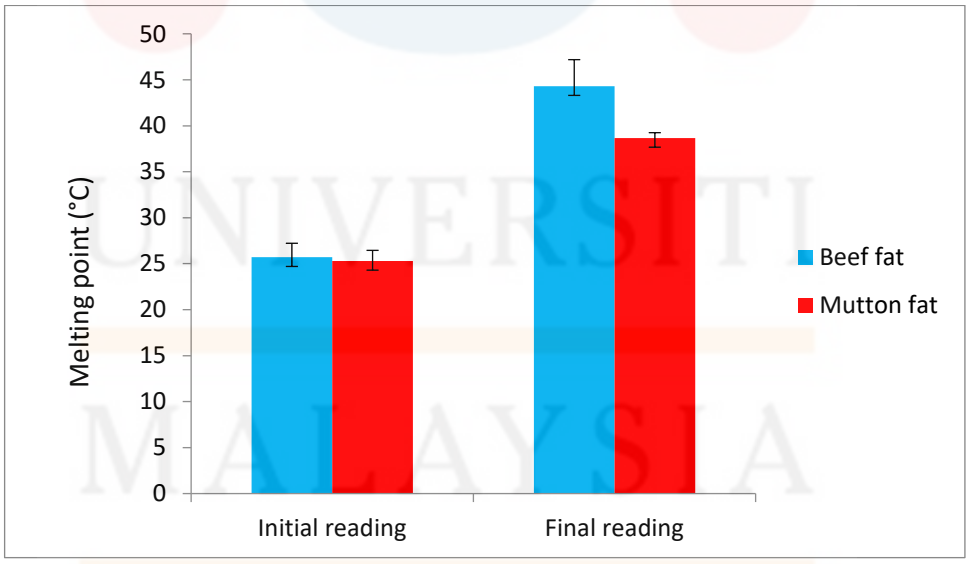

Figure 4.2: Determination of origin of beef fat and mutton fat by melting point method

After conducting the experiment, the initial temperature of mutton fats where it started to melt were ranged from 26ºC and 24ºC , while the final temperature of mutton

fats where its fully melt were ranged from 38ºC and 39ºC. Whereas, the initial temperatures of beef fat for 3 replications were 27ºC, 26ºC and 24ºC, while the final temperatures were ranged from 46ºC and 41ºC. Based on the table above, after obtaining the initial and the final reading of the fats sample for 3 times during the experiment, the melting point of beef fat was higher than mutton fat which was 44.33 ˚C for beef fat and 38.67 ˚C for mutton fat.

Fats melt at different temperatures, mainly due to their fatty acid characteristics. Fats with a higher concentration of saturated fatty acids and longer hydrocarbon chains will require a higher temperature to melt. Fats with trans fatty acids, with a "trans" configuration, will melt at higher temperatures than unsaturated oils, with a "cis" configuration. The location of double bonds in the hydrocarbon chain and the orientation of the fat molecules in the crystal form, will also affect the melting point. That is why beef fat took longer time than mutton fat to melt.

From the results (Table 4.1), we can discuss that the average melting point for mutton fat was 38.67ºC, while the average melting point for beef fat was 44.33ºC. This shows that beef fat had higher melting point than mutton fat. This also proves that mutton fat and beef fat are saturated fat since it needs high temperature to melt.

Mutton fat is the fat obtained (usually as a by-product) from mutton's meat rendering and processing. It is high in linoleic acids, the beneficial omega-6 fatty acid (Nutter *et al.,* 1943). Melting point was determined by the shape of the fat molecule, which can't exactly see in the line structures, and how the molecules pack together. The shape is related to how many double bonds there are. Saturated fatty acids are extremely fexible, they can bend and pivot around each of the carbon links and they normally stretch out into a straight line that easily stacks together to form solids. Oils have more

double bonds, which can't pivot, so they're more "bent out of shape," which makes it harder for them to pack together. More double bonds = less saturated = lower melting point = more likely to be oil. How the molecules pack together also makes a huge diference. Triglycerides can solidify into three possible crystalline structures, each with its own melting point. There are also some technical differences related to isomerization.

In many situations, it is not necessary to know the SFA over the whole temperature range, instead, only information about the temperature at which melting starts or ends is required. A pure triacylglycerol has a single melting point that occurs at a specific temperature. Nevertheless, foods lipids contain a wide variety of different triacylglycerols, each with their own unique melting point, and so they melt over a wide range of temperatures. Thus the "melting point" of a food lipid can be defined in a number of different ways, each corresponding to a different amount of solid fat remaining (McClements, 2005).

Some of the most commonly used "melting points" are *clear point* is a small amount of fat is placed in a capillary tube and heated at a controlled rate. The temperature at which the fat completely melts and becomes transparent was called the "clear point". *Slip point* is a small amount of fat was placed in a capillary tube and heated at a controlled rate. The temperature at which the fat just starts to move downwards due to its weight is called the "slip point". *Wiley melting point* is a disc of fat is suspended in an alcohol-water mixture of similar density and then is heated at a controlled rate. The temperature at which the disc changes shape to a sphere is called the "Wiley melting point".

4.3 Determination of Iodine Value of Beef Fat and Mutton Fat.

Table 4.3.1: The titration volume for the standardized sodium thiosulphate, $Na_2S_2O_3$

Test	Initial burette reading(ml)	Final burette reading(ml)	Total $Na_2S_2O_3$ (ml) used	Colour changes
No adding starch	0.0	21.3	21.3	Yellow
After adding starch	21.3	21.7	0.4	Colourless

The initial volume of $Na_2S_2O_3$ was 0.0ml while the final volume was 21.7ml after starch is adding into the fat sample. Total sodium thiosulphate volume has used to titrate was 21.7ml.

Table 4.3.2: The titration volume for beef fat sample

Test	Initial burette reading(ml)	Final burette reading(ml)	Total $Na_2S_2O_3$ (ml) used	Colour changes
No adding starch	19.2	34.3	15.1	Red
After adding starch	34.3	34.5	0.2	Colourless

The initial volume of $Na_2S_2O_3$ was 19.2ml while the final volume was 34.5ml after starch is adding into the fat sample. Total sodium thiosulphate volume has used to titrate was 15.3ml.

Table 4.3.3: The titration volume for mutton fat sample

Test	Initial burette reading(ml)	Final burette reading(ml)	Total $Na_2S_2O_3$ (ml) used	Colour changes
No starch	21.7	37.9	16.2	Red
With starch	37.9	38.2	0.3	Colour-less

The initial volume of $Na_2S_2O_3$ is 21.7ml while the final volume is 38.2ml after starch is adding into the fat sample. Total sodium thiosulphate volume has used to titrate is 16.5ml.

Table 4.3.4: The final result of $Na_2S_2O_3$ used in titration and iodine value

	Beef fat sample	Mutton fat sample
Total volume(ml) of $Na_2S_2O_3$ used to titrate (Blank - Test)	6.4	5.2
Iodine value	4.064	3.302

By using the standardized $Na_2S_2O_3$ to minus the $Na_2S_2O_3$ has used in fat sample. Mutton fat sample has used 6.4ml of $Na_2S_2O_3$ and has 4.064 of iodine value whereas beef fat sample has used 5.2ml of $Na_2S_2O_3$ and has 3.302 of iodine value.

Iodine value is a measurement to estimate the amount of unsaturation present in fatty acids presents the carcass fat. Since unsaturated fatty acids are 'softer' or less firm, iodine value can used as indicator of overall carcass fat firmness (Joel DeRouchey, 2011). Low of iodine value showed that the quality of the meat is good, because unsaturated fats are less stable than saturated fatty acids. This makes them more vulnerable to rancidity. Rancidity is the oxidation of fats that is caused by hydration (water), oxidation (oxygen), metallic atoms or microbes. Rancidity often produces unusual odor taste.

Mutton fat demonstrated a higher degree of unsaturated fatty acids compared with beef fat and therefore more prone for rancidity (Gerhard Feiner, 2016). The presence of light demonstrates a large impact toward obtaining and speeding up the process of rancidity. It is well known that fatty meat (or fat), stored in darkness at freezing temperatures, develops rancidity at a much slower rate than if the same materials would be stored at the same temperatures under the impact of light

In this study also, analysis of determination iodine value from fat samples is done by Hanus method which is the method for determining the iodine value of oil or fat that consist the addition a mixture of iodine and bromine in glacial acetic acid. Besides that, it also estimates the excess of unused halogen by titration with sodium thiosulfate.

The iodine value is a method for checking the unsaturation level in fatty acids depending upon the degree of unsaturation. The fatty acids can combine with oxygen or halogens to form saturated fatty acids.

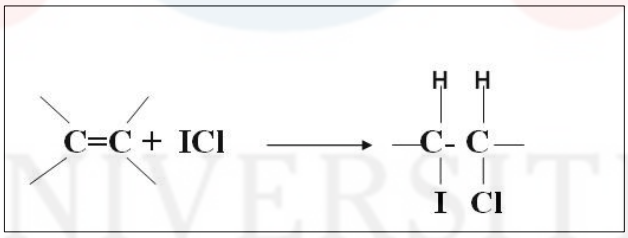

Figure 4.3.1: Example of chemical composition unsaturated fatty acids

Fatty acids react with a halogen which is an iodine, resulting in the addition of the halogen at the C=C double bonds site. In this reaction, iodine monochloride reacts with the unsaturated bonds to produce a di-halogenated single bond, of which one carbon has bound an atom of iodine (Amrita, 2011).

Iodometry is a iodometric titration in which a method of volumetric chemical analysis, a redox titration where the appearance or disappearance of elementary iodine

indicates the end point. Redox titration using sodium thiosulphate, $Na_2S_2O_3$ as a reducing agent where the fatty acid is treated with an excess of the Hanus or Wijs solution, which are, respectively, solutions of iodine monobromide (IBr). Unreacted iodine monobromide is then allowed to react with potassium iodide, converting it to iodine, whose concentration can be determined by titration with sodium thiosulphate.

After the reaction is complete, the amount of iodine that has reacted is determined by adding a solution of potassium iodide to the reaction product.

$$IBr + KI \rightarrow KBr + I_2$$

Equation 4.3.1: A balance chemical equation of iodine monobromide with potassium iodide

The remaining unreacted IBr then formed molecular iodine and the emancipated I_2 is titrated against with a standard solution of 0.1 M sodium thiosulphate.

$$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$$

Equation 4.3.2: A balance chemical equation of iodine with sodium thiosulphate

Starch is used as the indicator for this reaction so that the liberated iodine reacted with it since it can absorb the released I_2 and thus the endpoint can be observed. Starch is added only after solution turned pale straw yellow because the iodine should be liberated from the fatty acid moiety first so that once it separated completely, free iodine is obtained (indicates pale yellow colour) and starch is added by then slowly continue titrated until the end point turned colourless or pale pink.

A blank titration was carried out by titration a fixed and known concentration of titrant into a solvent with zero analyte. The only difference from the regular titration is the absence of analyte (LibreTexts, 2016).

From Table 4.3.4, amount of titrated 0.1M sodium thiosulphate solution ($Na_2S_2O_3$) used for beef fat is 6.4ml and mutton fat is 5.2ml. This is calculated by using subtraction method of Blank with Test sample (Blank - Test).

From the calculation, iodine value for beef fat was 4.064 meanwhile mutton fat was 3.302. Literally, iodine value in mutton fat sample is lower than beef fat sample which indicated that mutton fat has higher degree of unsaturation of fatty acid.

4.4 Compare in Viscosity of Mutton Fat and Beef Fat using Viscometer.

Viscosity of beef fat and mutton fat was conducted by using viscometer. The difference in the fat recovery rates in the different studies was probably because of fatty acid composition. Fatty acids are classified according to the presence and number of double bonds in their carbon chain. Saturated fatty acids (SFA) contain no double bonds, monounsaturated fatty acids (MUFA) contain one, and polyunsaturated fatty acids (PUFA) contain more than one double bond. Mutton fat has shorter chain fatty acids and ones with greater unsaturation are less stiff and less viscous, making the membranes more flexible. The viscosity (Pa.s) of beef fat and mutton fat which is 63.87 Pa.s and 47.13 Pa.s respectively. Beef fat has highest viscosity than mutton fat.

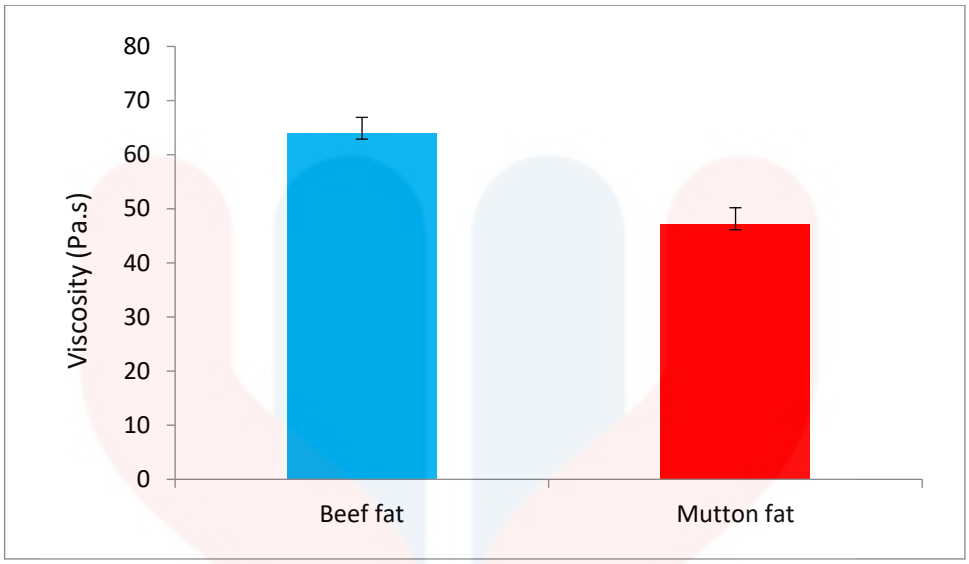

Figure 4.4: Viscosity (Pa.s) of beef fat and mutton fat

CHAPTER 5

CONCLUSION AND RECOMMENDATION

This study focused on chemical composition of mutton fat and beef fat involving determination of iodine value, origin of fat samples by melting point method and viscosity of fat samples. The study was carried out to understand in making comparison between mutton fat and beef fat by using different chemical analysis. In conclusion, fat extraction yield in beef fat was higher than fat extraction yield of mutton fat. Similarly, melting point, iodine value and viscosity of beef fat were higher than the mutton fat.

The fat yield of the fat was determined after the wet rendering process. The difference in the fat recovery rates in the different studies was probably because of the different animal meat abdominal fat tissues. Iodine value was recognised to indicate the amount of unsaturated fatty acid. The higher the iodine value, the lower becomes the melting point. The most important application of the iodine value is to determine the amount of unsaturation contained in fatty acids. Based on our result, we concluded that iodine values for beef and mutton were 4.064 and 3.303 respectively. . The iodine value is significant to show an ability of fats to been oxidized. Hence, a different iodine value that had been obtained from mutton fat and beef fat are due to existing double bond in unsaturated fatty acid. Therefore, consumption of mutton is better than the consumption of beef since amount of oxidation for mutton fat is lower than beef fat. The aim of this experiment is to indicate of the origin of fat.

Determination of origin of fat samples by melting point method is focused on the fats melt at different temperatures, mainly due to their fatty acid characteristics. Unsaturated fatty acids or beef fats have lower melting points than saturated fatty acids of the same length. Because double bonds cause the hydrocarbon chain to bend. Therefore, the fatty acids cannot compact tightly together, reducing the van der Waals interaction between the fatty acids.

For viscosity, both length and saturation of fatty acids affect the arrangement of the membrane. Shorter chain fatty acids and ones with greater unsaturation are less stiff and less viscous, making the membranes more flexible. The viscosity (Pa. s) of beef fat and mutton fat which were 63.87 Pa.s and 47.13 Pa.s respectively. Beef fat has highest viscosity than mutton fat.

In my study, only beef fat and mutton fat were used, for futher studies more species such as poultry or fish can be used to carry out chemical characterisation of fats. More parameters such as nutritive values and fatty acids content can be study by using different species of animal fats. This study also need to follow proper analytical methods and need more replication on getting mean for every parameters for better results.

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APPENDIX A

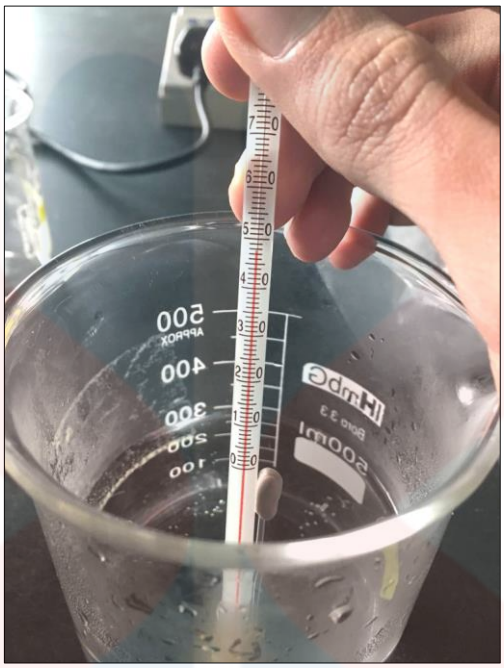

Figure A.1: Determination of origin of fat samples by melting point method

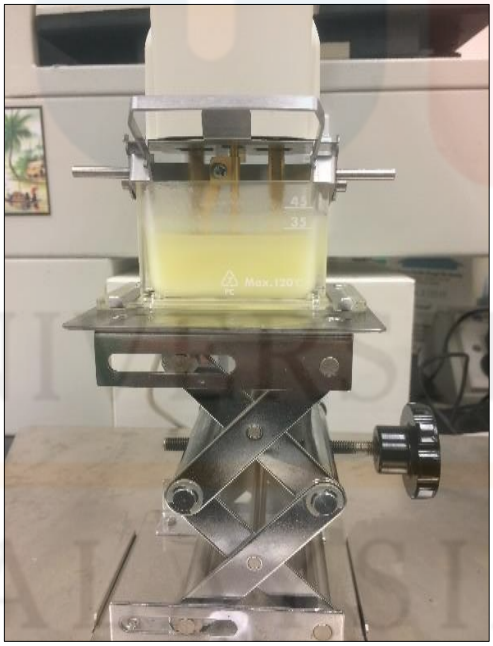

Figure A.2: Viscosity of mutton fat

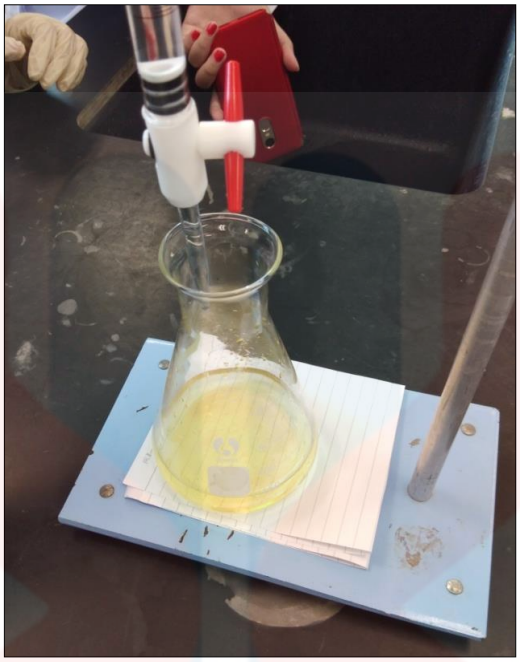

Figure A.3: Determination of iodine value of supplied fat samples