



Meat: Valuable Animal-Derived Nutritional Food. A Review

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Authors contributed equally in the study design, write up and read and approved the final manuscript.

Article Information

DOI: 10.9734/AFSJ/2020/v15i130140

Editor(s):

(1) Vijaya Khader, Acharya N. G. Ranga Agricultural University, India.

Reviewers:

(1) Florence A. Bello, University of Uyo, Nigeria.

(2) Xochitl Ruelas-Chacon, Universidad Autonoma Agraria Antonio Narro, Mexico.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/55844>

Received 27 January 2020

Accepted 03 April 2020

Published 09 April 2020

Review Article

ABSTRACT

This article reviews meat as an animal-derived protein food needed in the diet for improved human nutrition. To achieve high-quality biological protein that offer health-promoting effect in the human system, meat accordingly, is a rich source of nutrient matrix in a diet for the human system nourishment. Mechanisms associated in obtaining meat from animal skeletal muscle through the chemical and biochemical process are reviewed whereas, major nutritional constituents offered by meat concerning amino acids, minerals and vitamins and a good origin of energy functionalities it supplies in any healthy and balanced diet that can aid in human life development stages through quality meat intake are addressed.

Keywords: Meat; nutrition; exsanguination; marbled meat; meat quality.

1. INTRODUCTION

The skeletal muscles of animals that are edible yet highly putrescible through biological

composition are meat. Meat serves as a primary source of animal protein and therefore, a balanced and varied diet contains meat as a primary dietary component [1]. Meat is

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considered as the most vital food widely consumed by people and yields numerous nutritional functionalities from animal protein source in the human diet upon consumption [2,3]. An appreciable amount of vitamin B₁₂ and its other B complex vitamins, iron, zinc, selenium, and phosphorus as well as a rich source of high biological value protein can be obtained from meat with fat and fatty acid profile of meat imputable to dependent factors such as feeding system, species and cut used [4]. Etherington and Bardsley, [5], revealed that a third of the weekly household food budget is spent on meat and meat products because meat has a unique place in our diet and considered to be the vital component of meal, whereas, [6] indicated that, the profit margin of meat is appreciably increased when raw meat is changed into valuable products through processing means as well as efficiently prolonging shelf-life of the meat products.

Meat processing involves transformation means which include mechanical actions or ingredients added to raw meat to change it into different valuable products for intake and storage [6,7]. Processed meat, therefore, is regarded to be meat transformed via single or multiple means of salting, curing, fermentation, smoking or the addition of chemical preservatives for flavor enhancement and shelf-life extension [8]. Sausages, frankfurter, bacon, meatloaf, burgers, and others are among the various processed meat products since it is uneasy to sort processed meat products into categories [6,9,10].

Globally, meat intake is continuously on the rise each day as a percentage of meat that is cut in modern slaughter houses provides essential nutrients in the human diet [11] thereby making cuts and joints option at the butcher's shop or supermarkets counter to be carefully picked as meat is regarded as an expensive commodity [5]. Yet, health-related issues associated to malnutrition alarming rate coupled with under nutrition or overweight rate among at least 1 in 3 children under 5 or over 200 million, while approximately, 2 in 3 children between six months and two years old are not provided with food that supports their development reported by UNICEF [12]. Furthermore, hidden hunger caused by a lack of essential nutrients is considered to be one of the 21st-century child malnutrition comprehensive assessment forms revealed, as, more children and young people are alive, on the other hand not thriving at infancy and into adolescence crucial life

development stages [12]. Meat consumption provides essential nutrients to the body hence considering meat as a nutrition source in diet, meat intake should be of major concern to people everywhere due to the many varying nutritional roles it provides which can intervene the variable food nutritional challenges in present times considering the hunger ending, food security achievement and boost nutrition, and sustainable agriculture aim in achieving United Nations (UN) 2030 agenda for sustainable development.

Considering the valuable nourishment consumers obtain from meat which remains a great benefit to mankind, research findings by [13] revealed a double in meat average intake per capita in the world while [14] reported a growing global demand for meat following the more than quadrupled production of meat in the past 50 years as 320 million tons of meat is produced every year globally.

Hence, this review seeks to address the nutrition of meat as an animal-derived protein food in terms of reviewing; animal muscles biochemical conversion to meat processes, the effect muscle structure has on meat and the major chemical compositions and pivotal roles meat offer to man in line with meat quality characteristics as remedies that are of great need to meet the human nutrition concerns.

2. MUSCLES TO MEAT CONVERSION BIOCHEMICAL PROCESSES

Blood supplies oxygen and nutrients to diverse areas of the animal body and the muscle cell normal metabolic processes. In muscles specific locations, several chemical reactions form metabolic pathways result in adenosine triphosphate (ATP) formation whereas, glucose is stored like glycogen for energy provision to the muscles. Lipid and creatine phosphate (CP) are also energy stored in the cells. Muscle is regarded as highly ATP demanding tissues because in as much as ATP is required for metabolic reactions and ion transport, it again allows the myosin head on the thick filament to detach and relax from its bound state to actin accordingly. The readiness of ATP is chiefly dependent on three sources: muscular ATP and phosphocreatine (PCr) reservoirs, oxidative phosphorylation and anaerobic glycolysis because, CP initiates ATP synthesis later by glycogenolysis and glycolysis. Homeostasis therefore enables the body system to maintain

internal temperature with the help of the endocrine and nervous systems. After sticking, the body in an attempt to keep homeostasis control constant due to the various biochemical and metabolic actions occurring during exsanguination (blood outlet) fails. Exsanguination precedes muscle conversion to meat as approximately 50% of the animal's blood supply is removed. Anoxia (reduction of oxygen supply) occurs throughout the animal's organ and tissues allowing anaerobic glycolysis to substitute aerobic respiration because ATP which is synthesized and used by muscles fails to execute muscle cells homeostasis process (keep a relaxed sarcomere) but instead makes way for glycogen and high energy phosphate compounds existence in the muscles leading to rigor mortis or muscle stiffness which is actomyosin formation due to a permanent bond of myosin globular head to actin filaments. Lactic acid and hydrogen ions (H^+) are produced from the process of glycolysis resulting to a decline in muscle pH (from 7.0-7.5 in living tissues to 5.0-5.6 in meat) as ATP decline to 0% thus the muscular system to lose stretch-ability and become rigid (irreversible actomyosin complex) termed as rigor mortis [15,16,17,18]. Meat quality attributes (colour, juiciness, tenderness) clings on the biochemical changes that occur in muscle conversion to meat processes considering the slaughtered animals antemortem and post-mortem changes coupled with temperature and pH. The consequences of antemortem and post-mortem changes of slaughtered animal does not only affect fresh meat quality rather other marketable processed products of same meat because meat quality characteristics changes as meat pass through the production chain (slaughter→ processors→ retailers→ consumer) making quantity and value of meat a key determinant of price consumers consider in meat and meat product purchase [19]. On one hand, species, muscle fiber type, and ante and post-mortem conditions lead to rigor mortis through the rapid occurrence of continual pH falls owing to anaerobic glycolysis converting stored glycogen to lactic acid formation to yield hydrogen ion (H^+) accumulation. Pre-slaughter factors suchlike sex, breed, age and feeding (nutrition), and post-mortem factors such as handling (suspension of carcass during slaughter), electrical stimulation, storage modalities (chilling rate aging, freezing, thawing) and cooking, on the other hand, have an impact on meat quality [20,21]. Animals exposed to stress before slaughter leads to rapid commencement of rigor mortis due to the surge

in lactic acid threshold in muscle. To effectively achieve quality meat to suit consumers preference, the various animal handling practices before slaughtering and slaughtering process should be importantly considered to yield quality meat for consumption. Hence, several handling and slaughtering mechanisms as a remedy to achieve quality meat by reducing pale soft exudative (PSE) and dark firm dry (DFD) meats occurrences in the meat enterprise in-depth study on physical and chemical post-mortem changes developments influencing meat quality are outlined by [19]. Again, a typical adult mammals muscle chemical and biochemical composition after rigor mortis but before deteriorative post-mortem changes are presented in a summarized tabulated form by [22].

3. MEAT MUSCLE STRUCTURE AND EFFECT ON MEAT QUALITY AS FOOD

Skeletal (striated), cardiac and smooth muscles are the three muscle types that facilitate locomotion and assistance to the body with sarcomeres known to be the functional units of a muscle or the contractile unit of muscle fiber. Skeletal muscle is the largest consumable portion of various animal species meat [23] and is made of 90% muscle fiber and 10% of both connective tissue and fat at a microscopic scale [24]. Muscles are living tissue designed primarily for forces production and animal body movement as well as to carry primarily in vivo roles [25] and therefore, surrounded by a sheath of connective tissue called epimysium. Perimysium serves as a separation septum that contains larger blood vessels and nerves with endomysium acting as a fine connective tissue framework surrounding each muscle fiber [26]. Epimysium, perimysium, and endomysium twist together to yield contractile force from cell level to bones or other body tissues for locomotion because they contain mainly the collagen fibers [23]. Epimysium is the whole muscle structure's greatest level of connective tissue layer serving as muscle external envelope, perimysium separates muscle in fiber bundles and endomysium enfold each muscle fiber [24]. Skeletal muscle fiber has sarcolemma (plasma membrane) as an outer surrounding membrane of the muscle cell, transverse tubules (T-tubules) stores and releases calcium (Ca^{++} ions) for muscle contraction and relaxation processes. Sarcoplasmic reticulum (S.R) has T-tubules as a portion of its membranous system, mitochondria give the cell the needed chemical energy hence

it is known to be the “powerhouse of the cell”, myofibril and sarcoplasm are part of muscles microstructure likewise lysosomes having numerous catabolic enzymes capable of digesting the cell and its contents collectively. Myofibril takes about 80% of the skeletal muscle cell volume and also assists in the operations of muscle fiber [23]. Also, the sarcomere structure is interconnected and in order, having the light band as I-band (isotropic in polarized light) with dark band as A-band (anisotropic in polarized light). These light and dark bands created from myofilaments organization gives skeletal muscles characteristic striped or striated appearance [22]. The middle area of A-band is referred to as the H-zone with M-band found in its center. Z-disk comprises of Z-filaments which serve as connecting units between sarcomeres [25,27]. Thin filaments made-up of actin with regulatory proteins tropomyosin and troponins and thick filaments constituting myosin are the two sets of myofilaments that are longitudinally organized in the sarcomere [23,25].

Therefore, Muscle fiber (long, narrow, multi-nucleated cells) characteristics such as fiber size, fiber type dissemination, and relative composition have a linkage to meat quality attributes including color, tenderness, water holding capacity (WHC) and sensory qualities [28]. Connective tissue principally made of fibers of collagen which are straight, inextensible and non-branching and of elastin which is elastic, branching and yellow becomes much more resilient to breakdown by under a three-dimensional network formation and a high tensile strength development during animal's tissue maturation influences the quality attributes of meat to consumers as meat tenderness or texture is regarded in high esteem [26,29]. Regarding the resulting muscle composition meat is obtained after muscles have undergone various processes after the death of an animal [29]. Hence, meat is eaten as food due to the biological values and nutrients that meat supply to the body. It is taught that even the Paleolithic man was killing the animals for meat purposes and other vital economic gains such as the conversion of animal skin as clothes from the old history of mankind and animal relationship [22,30].

4. MEAT MAJOR CHEMICAL CONSTITUENTS AND FUNCTIONALITIES

Water (moisture) (75%), protein (19%), lipid (fat) (2.5%), inorganic matter (mineral or ash) (1%) and a small proportion of carbohydrates (1%)

makes up meat (skeletal muscle tissue). Other constituents involving non-protein nitrogen compounds (1.5%) such as nucleotides, peptides, creatine phosphate, urea, creatine, inosine monophosphate, nicotinamide-adenine dinucleotide and components including non-nitrogenous substances such as vitamins, glycolytic intermediates, organic acids form part of meat tissues chemical components [31,32]. However, the composition of meat varies based on the species of the animal, sex, age, diet and the climate and activity throughout the growing period of the animal [32]. The quantity of skin and bone as well as the incorporation of non-meat ingredients (e.g. salt, alkaline phosphates, sodium nitrate/nitrite, sugar, spices/ seasonings) are also factors that result in meat tissues primary chemical constituents (water, protein, and fat) and meat products variation [31].

4.1 Water

Water among the chemical components of meat is the major variable constituent as is closely and inversely related to lipid (fat) percentage, and a lower degree to the inorganic matter (ash) and carbohydrate content. This is because, carbohydrate percentage, however, remains constant as the fat content of meat increases, likewise, water (moisture) content declines until the animal body reaches chemical maturity irrespective of the species if the fat content is held relatively constant. In brief, as animal body increase in fatness while maturing, water percentage therefore declines. Protein is also inversely related to fat percentage [31,33].

Water exists in a free biologically active form and bound structural or protective form (4-5% held firmly) in muscle. Bound water which is the water that remains tightly by myofibrillar proteins and unmovable among water sections can only be removed through excessive drying processes although is resistant to freezing [34]. Bound water under the increment of force and temperature forces declines in the following order: ionic groups > polar groups > non-polar groups and the following involving factors such as hydrogen (H)-bond, alteration in pH and ionic strength, ionic groups electrostatic forces and protein molecules spatial arrangement also influences free water (water which is lost) [22]. According to Hamm [35], constitutional water is the very small portion of water (approx. 0.3%-0.5%) bound within myofibrillar proteins. Free water is retained within muscles by very weak capillary forces and flows freely from muscle

tissues. Immobilized water is retained inside myofibril tightly to bound water by steric effects or attraction but does not bond with myofibrillar protein, yet, through conventional heating immobilized water can be removed. After the rigor process, water that escapes from muscle cells as the purge is also called extracellular water [34,36].

Water percentage in muscle tissue affects nutritional and organoleptic characteristics of taste, smell, appearance (colour), texture and flavor of muscle (meat). Adipose tissue is thought to contain little water hence, water content totality is low in carcass or cuts of fatter animals. Water in muscle tissue prevails as free molecules at a large percentage within muscle fibres whilst a smaller amount is situated in the connective tissue yet some water can remain within muscle fibres in the course of storage, curing and heat treatment due to fibers 3-D structures [37]. Water as the fluid medium of the body serves as primary constituent of cellular and organ metabolism and functions as a mode of transportation for metabolites and waste products, thermo-regulator, solvent, and lubricant. Therefore, animal's excessive loss of water leads to meat colour fading because myoglobin (primary pigment for meat colour) is water-soluble [31,36]. On the part of water-protein interaction, water, and amino acids which are the building units of proteins strongly attract and bond with myofibrillar protein, glutamic acid, and lysine because they possess charge side groups. On the other hand, glutamine and tyrosine contain nitrogen and oxygen atoms in side groups possessing enough polarity imputable to electron concentration to attract and bind water. Leucine, alanine, and valine repel water due to factors such as: being electrically neutral and non-polar (hydrophobic because they are solely composed of carbon and hydrogen atoms). Water dipoles H:O:H two duos of valence electrons and water is a dipolar molecule that attracts and binds to charged molecules and is found in portioned section in muscles [22,36,38].

4.2 Protein

Proteins are composed of amino acids (building blocks). The muscle protein constitutes 16-22% of skeletal muscle weight and composed of more than 20 amino acids connected through a peptide linkage as a complex nitrogenous component, hence protein serves as the origin of essential amino acids (threonine, phenylalanine, lysine, valine, tryptophan, leucine, methionine, isoleucine) beneficial for human nourishment.

Muscle protein includes myofibrillar protein, connective tissue, and organelle or stromal proteins and sarcoplasmic proteins that perform contractile, connective or support and metabolic functionalities respectively [31,39,40]. Protein functionalities include; serving as enzymes, transporters, hormones, antibodies, receptors, and the development, sustaining and repairing of body tissues [41]. Myofibrillar protein is soluble in concentrated salt (e.g. KCl 0.3 ionic strength solution) and include: myosin, actin (G-actin and F-actin), tropomyosin, troponin complex (troponin C, I and T), desmin, titin, nebulin, vinculin, actinins (α and β form) and several others and are in charge for contractile mechanism (shorten and lengthen) of muscle movement and functional assistance. Sarcoplasmic proteins are water-soluble or soluble in diluted salt solution (0.06 low ionic strength) and are composed of oxidative enzymes (flavin nucleotides, cytochromes), heme-pigments (myoglobin), lysosomal enzymes (hydrolytic breakdown of waste material), nucleoproteins (protein synthesis and deposition regulation), mitochondrial oxidative enzymes and glycolytic enzymes which control both aerobic and anaerobic glycolysis thereby assisting in the transformation of glycogen to lactic acid and the aerobic oxidation of pyruvate. Primarily, sarcoplasmic proteins are shown by enzymes and myoglobin and stroma proteins are generated from the muscle connective tissue structure. Connective tissue protein therefore comprises of collagen (quantitatively most vital) and elastin embedded in the glycoprotein matrix. Collagen therefore is resistant to most enzymatic reactions due to its triple-helical molecule except collagenase hence it is extracted with strong acid or alkaline solution or digested with pepsin and collagenase. On the other hand, elastin is less concentrated but even more resistant to degradation, cooking and enzymatic digestion due to its significant proportion of nonpolar amino acids isodesmosine and desmosine cross-linkage between adjacent polypeptide chains which provide vital structural aid to elastin due to their tetracarboxylic-tetra-amino functional groups allowing a cross-link of several chains of amino acid residue. Elastin is present in ligaments whereas collagen includes tendons, ligaments, bone, skin, and cartilage [22,31,33,42]. Actin and myosin linkage during contraction of the muscle is known as actomyosin. Reticulin (fibrous protein similar to collagen) and ground substance (plasma protein and glycoprotein) are recognized protein components found in meat connective tissues [42].

4.2.1 Synopsis of protein digestibility corrected amino acid score (PDCAAS) and digestible indispensable amino acid score (DIAAS)

Based on well-accepted concept with respect to possible distinction of proteins nutritional value established on the composition and digestibility of essential amino acids, protein digestibility corrected amino acid score (PDCAAS) was considered the best-suited procedure by FAO/WHO for the routine evaluation of overall protein quality for individuals and the acceptance of PDCAAS method as a preferred established method at the international level was advocated [43,44]. Therefore, PDCAAS is regarded as an evaluation method used to assess protein quality with a maximum possible score of 1.0 by expressing the content of the first limiting essential amino acid of the test protein as a percentage of the same amino acid in a reference pattern of essential amino acids based on the essential amino acid conditions of the 1-2-year-old child according to (FAO/WHO/UNU) report published in 1985 and corrected for protein digestibility founded on true fecal nitrogen digestibility. The growing rat is used as a PDCAAS model for adult human protein nutrition measurement [43,45,46,47]. Schaafsma [47], protein digestibility corrected amino score (PDCAAS) formula is expressed as;

$$PDCAAS (\%) = \frac{\text{mg of limiting amino acid in 1 g of test protein}}{\text{mg of same amino acid in 1 g of reference protein} \times \text{faecal true digestibility (\%)}} \times 100$$

Digestible indispensable amino acid score (DIAAS) conversely is a recommended evaluation method for protein quality of human food by the Food Agricultural Organization of the United Nations (FAO) expert consultation used to overcome the limitations of the PDCAAS system utilized since 1991. DIAAS is a preferred adopted evaluation method due to some identifiable number of problems or shortcomings associated with PDCAAS values including; (a) the calculation of inaccurate values using PDCAAS procedure sometimes and (b) protein digestibility inability to reflect the digestibility of individual dietary indispensable amino acids always [43,48]. Also, the pig is considered a preferably better model to the rat in determining the ileal digestibility of amino acid in food protein in the absence of human data [43,49].

According to FAO [44], protein requirements are defined in terms of consumption needed to meet metabolic requirements for maintenance as

indicated by nitrogen stability in the corresponding age group including those associated with the protein needs for normal growth of infants and children, pregnancy and lactation in women. Therefore, digestible indispensable amino acid score (DIAAS) values are calculated by multiplying each indispensable amino acid digestibility by the protein amino acid concentration and comparing the values to a scoring pattern [43,48,49].

FAO [44], the formula of the digestible indispensable amino acid score (DIAAS) is expressed as;

$$DIAAS\% = 100\% \times \text{lowest value} \left[\frac{(\text{mg of digestible dietary indispensable amino acid in 1 g of the dietary protein})}{(\text{mg of the same dietary indispensable amino acid in 1g of the reference protein})} \right]$$

Consequently, meat as an animal protein is regarded as a good example of complete protein since proteins are grouped as either complete or incomplete. Protein in food is considered incomplete when one or more amino acids are unavailable in sufficient amounts whereas, the presence of a sufficient amount of all essential amino acids makes a protein in food complete. DIAAS, therefore, considers individual amino acid digestibility rather than protein digestibility and also highlights on ileal digestibility utilization in determining digestibility in humans instead of fecal digestibility [50]. High digestibility is among other factors such as better amino acid score (AAS) and greater water solubility that makes animal source proteins to be of higher quality as compared to proteins from plant source [51], therefore meat is importantly a prolific source of complete protein for life-essential functions.

4.3 Fats and Fatty Acid

Lipids are insoluble in water yet soluble in organic solvents (e.g., acetone, ether) and major lipid categories include; fats, phospholipids, steroids, and waxes. There are numerous quantities of fat contained in the fatty tissues of meat. The fat cells (adipocytes) are filled with lipids, a major portion deposited in adipose tissue. Extracellular lipids in meat muscle tissues are in fatty deposits and these available fat contents are known as triglycerides which are esters of three fatty acid chains and the alcohol glycerol. In animals, the most plentiful monoenoic fatty acid and saturated fatty acids found include oleic acid (18 carbon atoms, 1 double bond), and palmitic acid (16 carbon atoms, no double bonds), and stearic acid (18 carbon atoms, no double bond) respectively with different compositions

depending on the animal sex, species, and environment [52,53,54]. Sources of lipid in meat are grouped into four namely; the intramuscular fat (marbling), intermuscular fat (seam fat), subcutaneous fat (fat on carcass) and internal fat (found within the body cavity). The amount of fat within muscles is considered as intramuscular fat (IMF) whilst the word marbling refers to the white flecks or streaks of visible IMF between muscle fiber bundles [55]. Lipoprotein and phospholipids and metabolites are small portions of lipids such as fatty acids that exist within muscle cells which are essential constituents of mitochondria, sarcoplasmic reticulum, and cell membrane, however, fat presence varies among the various retail cuts of meat and meat products as skin serve probably the core source of fat in poultry meat [4] and whereas meat consumers in Asia (e.g., Japan, Korea, Taiwan) prefer to have moderate content of IMF in meat they buy, visible fat in meat is unpopular during purchase among Western (e.g., Australia, Europe) meat consumers [56].

In as much as the composition of fat in meat seems unpopular among meat consumers in several countries, the presence of fat in meat vital roles include; it affects meat juiciness by enhancing the water holding capacity of meat, serving as energy deposit, function as a lubricant by lubricating meat muscle fibers during cooking, intramuscular fats (in and around muscle fibres) also lubricate muscle fibers and fibrils to yield a more tender and product that potentiates the sensation of tenderness (lubrication theory), protection-wise, fat gives insulation against body temperature losses [52,53,57,58] and cushion and protect organs. The high amount and distribution of IMF or marbling has been associated to improved attribute of meat intake such that marbling fat in meat muscle probably influences tenderness due to the single or combined effects of tenderness associated mechanisms namely; bite theory, strain theory, lubrication theory, and insurance theory [57,59]. Flavour enhancement, shelf-life, and tissue firmness are all factors that influence meat quality by fatty acid deposition. Between muscular fibres, fat deposition has been a considerable factor in ascertaining meat grade therefore, marbling score and intramuscular fat are very well attributed with meat quality grade in the USDA beef grading system [60]. Pannier et al. [61], associated the eating qualities (flavor, tenderness, and juiciness) in red meat to be the result of intramuscular fat percentage positive impact.

Considering strategic feeding in the past years, several researches among livestock industries showed an increased IMF content with meat quality other than eating quality in the aim of manipulating the fat proportion and fatty acid composition of muscle and fatty tissue high level of IMF improvement among pigs fed with protein or lysine deficient diets at growing or finishing phases of their production cycle [59]. Dodson et al. [62], stated genetic or breeding selection, feeding strategies, housing, and environmental strategies and hormone supplementation to be efforts to reducing lipid deposition and selective lipid deposition as strategic means for enhancing production efficiency as well as improving meat quality of meat animals. Also, based on a paradigm shift in livestock production from large amount of high-value protein into the promotion of secure and highly convenient meat of consistent eating attributes and production of meat with desirable nutritional and technological attributes, the relationship between IMF level (minimum) and meat quality to achieve consumers satisfaction has been studied by several researchers [55,59]. IMF function in meat serves as a substrate and a reservoir for flavor compounds inferring to reason why meat consumers from Asia (e.g., Japan, Taiwan, Korea) prefer meat with moderate marbling amount [56].

Fats are stored in the adipose tissue for energy and can be saturated or unsaturated, saturated fats are related to health issues for example increase in chances of cardiovascular disease development, colon cancer, and obesity by influencing low-density lipoprotein cholesterol blood levels whilst unsaturated fat lowers low-density lipoprotein and minimizes risk for diseases [63,64].

Meat, therefore, has an average of 50% saturated fatty acid (SFA), 40% monounsaturated fatty acid (MUFA) and 10% polyunsaturated fatty acid (PUFA) according to Wood et al. [52] and that, meat fatty acids are of medium to long-chain carbon atoms (12-22 atoms) with $\text{CH}_3\text{-(CH}_2\text{)}_n\text{-COOH}$ as its basic structure. Based on fatty acids chemical composition in fat depot and fatty acids effects on meat quality, ruminant's fatty acid profile is more of trans-fatty acids due to microbial biohydrogenation in the rumen than that of monogastric (e.g., pigs). SFA is highly concentrated in ruminants while pigs have higher unsaturated fatty acids (UFA) in their fat tissues thereby making ruminant adipose tissue

firm or hard in nature. Considerably, lamb's fat is, therefore, the hardest followed by cattle with pigs having softer fat [60,64,65]. Likewise, linoleic acid (C-18:2) is higher in lean meat of pig than in sheep meat [53]. Yet, fatty cattle possess soft fat due to an increase with the oleic stearic acid and palmitic acids [66], whereas long chain omega-3 PUFA is richly obtained from meat (lean red meat) source naturally.

5. CONCLUSION

Inadequate energy and or protein consumption over a period time resulting in weight loss, lean body mass loss, stored fat loss and diminished functionality is referred to as malnutrition [67]. Monika and Mercedes, [68], regarded malnutrition as a serious public-health situation subjected to a sizable growth in the risk of death and sickness. Given the aforementioned health concern, meat steps in as a source of protein to provide a great benefit in the diet as a remedy to the malnutrition health-related issues. Meat industry players should consider meat quality factors associated with water holding capacity (WHC) which is of importance in both fresh and processed meat. Flavour, juiciness, tenderness should be of great interest to fulfil consumers meat quality satisfaction, therefore, antemortem and post-mortem effects must be noted whereas physiological age, environment, nutrition, heredity which are influential factors affecting meat composition must equally not be underestimated in the pursuit to achieve quality meat for people. Marble meat pays considering the meat fat (saturated vs unsaturated) and fat profile. Hence, emphasis should be given to marble meat achievement to avoid cardiovascular health-related challenges associated with fatty meat (saturated fat) intake reported by [69] but rather build consumers trust. Since cooking can have a major influence on meat fat content and fatty acid composition [4], the process of cooking meat or cooking conditions can be optimized to check meat fat content in terms of achieving quality meat. In as much as governments striving to realize United Nations (UN) sustainable development goals (SDGs) toward hunger end, improved nutrition is equally of global progress and interest therefore quality meat gives a purchasing drive to consumers due to health trust and nutritional roles realized to gain from meat intake thereby boosting the meat industry albeit there is a steady demand of meat globally.

ACKNOWLEDGEMENT

With gratitude, the authors acknowledge the support and funding given by Nanjing Agricultural University and Nanjing Forestry University for Postgraduate Studies, in P.R China.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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