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Comparative Analysis of Protein Content in Selected Meat Samples (Cow, Rabbit, and Chicken) Obtained Within Damaturu Metropolis

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Abstract

Protein content and palatability of meat from different sources differed, people preferred cheap and quality meat sources for their domestic use. Comparative analysis of protein content in selected meat samples were was carried out using Kjeldahl method. The result of the analysis shows that cow has the highest percentage crude protein of 23.47%, chicken has 18.66% and rabbit the least percentage crude protein of 15.00%. With the result obtained, it is, therefore, recommended that further research should be carry on out complete proximate nutritional analysis on meat samples. In conclusion, cow meat should be consumed for quality protein than the other two samples: chicken and rabbit, because cow does not cause any discomfort after a long period of consumption, unlike the chicken and rabbit.

Keywords

Chicken, Cow, Damaturu, Protein and Rabbit

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1. Introduction

Proteins are large biological molecules, or macromolecules consisting of one or more long chains of amino acid residues. Proteins perform a vast array of functions within living organisms, including catalyzing metabolic reactions, replicating DNA, responding to stimuli, and transporting molecules from one location to another. Proteins differ from one another primarily in their sequence of amino acids, which is dictated by the nucleotide sequence of their genes and which usually results in folding of the protein into a specific three-dimensional structure that determines its activity [3].

A linear chain of amino acid residue is called polypeptide. The protein contains at least one long polypeptide. Short polypeptides are rarely considered to be proteins and are commonly known as peptides, or sometimes oligopeptides. The individual amino residues are bonded together by peptide bonds to an adjacent amino acids residue. The sequence of amino acid residues in a protein is defined by the sequence of a gene, which is encoded in the genetic code. In general, the genetic code can include selenocysteine and in certain archea-pyrrolysine. Shortly after one or even during synthesis, the residues in a protein are often chemically modified by a post-transitional modification, which alters the chemical and physical properties, folding, stability, activity and ultimately the function of the proteins. Sometimes proteins have non-peptide groups attached, which can be called prosthetic groups or cofactors. Proteins can also work together to achieve a particular function, and they often associate to form stable protein complexes. Once formed, proteins only exist for a period and are then degraded and recycled by the cells machinery through the process of

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protein turnover [3].

Most proteins consist of linear polymers built from series of up to 20 different L-α-amino acids. All proteinogenic amino acids possess common structural features, including an α-carbon to which an amino group, carboxyl group, and variable side chain are bonded. Only proline differs from this basic structure as it contains an unusual ring to the N-end amine group, which forces the CO-NH amide moiety into a fixed conformation [11]. The amino acids in a polypeptide are linked by peptide bonds. Once bound in the protein chain, an individual amino acid is called a residue, and the linked series of carbon nitrogen and oxygen atoms are known as the main chain or protein backbone [4]. Proteins are an abundant component of all cells, and almost all except storage proteins are essential for biological functions and cell structure. Food proteins are very complex. Many have been purified and characterized. Proteins vary in molecular mass, ranging from approximately 5000 to more than a million Daltons. They are composed of elements including hydrogen, carbon, nitrogen, oxygen, and sulphur. Twenty α-amino acids are the building blocks of proteins; the amino acid residues in a protein are linked by peptide bonds. Nitrogen is the most distinguishing element present in proteins. However, nitrogen content in various food proteins ranges from 13.4 to 19.1% (1) due to the variation in the specific amino acid composition of proteins. Proteins rich in basic amino acids contain more nitrogen [14].

Proteins are essential nutrients for the human body. They are one of the building blocks of body tissue, and can also serve as a fuel source. Thus, the protein and lipid fraction of camel meat underwent considerable changes during refrigerated storage. Therefore, the behaviour of protein and lipid fraction in camel meat during refrigerated storage could provide a better understanding of the processing and storage conditions [13]. During human digestion, proteins are broken down in the stomach to smaller polypeptide chains via hydrochloric acid and protease actions. This is crucial for the synthesis of the essential amino acids that cannot be biosynthesized by the body [4].

Proteins are polymer chains made of amino acids linked together by peptide bonds. During human digestion proteins are broken down in the stomach to smaller peptide chains via hydrochloric acids and protease action. There is nine essential amino acids human must obtain from their diet to prevent protein–energy malnutrition. They are phenylalanine, valine, threonine, tryptophan, methionine, leucine, isoleucine, lysine and histidine. There is five dispensable amino acids human can be able to synthesize in the body; these are alanine, aspartic acids, asparagine, glutamic acid and serine. There are six conditionally essential amino acids whose synthesis can be limited in exceptional pathophysiological conditions such as premature in the infant or individuals in severe catabolic distress. These are arginine, cysteine, glycine, glutamine, proline and tyrosine [8].

Humans need the essential amino acids in certain ratios. Some protein sources contain amino acids in a more or less complete sense. This has given rise to various ranking systems for protein sources, as described in the article and proposed rabbit meat protein oxidation as a potential deteriorative change in refrigerated rabbit meat along with microbial spoilage and lipid oxidation [10].

Animal sources of protein include meats, fish, dairy products, and eggs. Vegan sources of protein include whole grains, pulses, legumes, soy, and nuts. Vegetarians and vegans get 'enough' essential amino acids by eating a variety of plant proteins [4]. It is commonly believed that athletes should consume a higher-than-normal protein intake to maintain optimal physical performance [4].

1.1. Functions of Protein in the Body

Protein is the nutrient needed by the human body for growth and maintenance. Aside from water, proteins are the most abundant kind of molecules in the body. Protein can be found in all cells of the body and is the major structural component of all cells in the body, especially muscles [7]. This includes body membranes, such as glycoprotein. When broken down into amino acids, co-enzymes, hormones, immune response, cellular repair, and other molecules essential for life. Additionally, protein is needed to form blood cells.

1.2. Protein Function in Exercise

Proteins are believed to increase performance in term of athletics. Amino acids, the building blocks of protein are used for building tissues and repairing damaged tissues. Protein is only used anaerobic fuel when lipid resources area also low [7].

1.3. Protein Structure

By convention, a chain of 40 residues is often identified as peptide rather than protein [15]. To be able to perform their biological function, proteins fold into one or more specific spatial conformations, driven by some non-covalent interactions such as hydrogen bonding, ionic interactions, Vander Waals forces and hydrophobic packing. To understand the functions of protein at a molecular level, it is often necessary to determine their three-dimensional structure. Protein structure ranges in size from tens to several thousand residues [1]. By physical size, proteins are classified as Nanoparticles, between 1-100nm. Very large aggregates can be formed from protein subunits. For example, many thousands of acting molecules assemble into a microfilament. A protein may undergo reversible structural changes in performing its biological functions. The alternative structures of the same protein are referred to as different conformations, and transitions between them are called conformational changes. There are four distinct levels of protein structure; primary, secondary, tertiary and quaternary [1,15].

1.4. Protein Requirement

The recommended protein intake for an average adult is based on body size 0.8 grams per kilogram (0.8g/kg) of body weight is usually recommended for daily intake. The recommended daily allowances of protein do not vary in times of strenuous activities or exercise, or with progressing age. However, there is a broad range of protein intake which people can consume according to their period of development. For example, the recommended allowance for an infant up to six months of age, who is undergoing a period of rapid tissue growth, is 2grams per kilogram (2g/kg), for children ages seven through ten, the recommended daily allowance is around 36 grams, depending on body weight. A pregnant woman needs to consume on additional 30grams of protein above the average adult intake for the nourishment of the developing fetus [9].

1.5. Deficiency of Protein

Protein is a macronutrient that is essential for the construction, maintenance and repair of all the body's cells. The body cannot survive without this nutrient. Failing to consume enough can have some negative side effects and ultimately leads to death. Protein deficiency normally affects people in developing countries who cannot get enough of this nutrient as a result of famine. It can also affect people in developed countries who make poor in choices, usually as a result of fade diets poverty. Vegetarians and vegans are also more susceptible to protein deficiency because they eat little or no meats and dairy products, when to compare a non-vegetarian diet. The followings occur as a result of protein deficiency; kwashiorkor, marasmus, impaired mental health, oedema, organ failure, wasting and shrinkage of muscle tissues, and weak immune system [7]. sources of protein include roots and tubers such as yams, cassava, and sweet potato. Plantains, another major staple, are also a poor source of amino acids. Food staples with low protein contents must be complemented with foods with complete, quality protein content for a healthy life, particularly in children for proper development [7]. The aim and objective of this analysis are to determine and compare the protein contents in the different selected animals; Cow, Rabbit and Chicken.

2. Methodology

The usual method of determining crude protein in meat products is by Macro Kjeldahl method. Food is digested with a strong acid so that it releases nitrogen which can be determined by a suitable titration technique. The amount of protein present is then calculated from the nitrogen concentration of the food. The same basic approach is still used today, although some improvements have been made to speed up the process and to obtain more accurate measurements. It is usually considered to be the standard method of determining protein concentration. Kjeldahl method does not measure the protein concentration. A conversation factor (F) is needed to convert the measured nitrogen per gram of protein concentration. A conversation factor of 6.25 (equivalent to 0.16g nitrogen per gram of protein) is used for many applications. However this is only on average value, and each protein has a different conversion factor depending on its amino – acid composition. The Kjeldahl method can conveniently be divided into three steps digestion, distillation, and titration [2].

i. Digestion

2g of the sample (chicken, cow and rabbit) was weighed in a small weighed dish and transferred into 500ml Kjeldahl flask. Then 2.5g of Na_2SO_4 was added by shaking gently 25ml of concentrated tetraoxosulphate VI acid an oxidizing agent which digest the food, and a speck of selenium was added to serves as a catalyst, to the sample in the Kjeldahl flask. The flask was then set up in slanting position on the Bunsen burner inside the fume cupboard and then heated strongly till the mixture was bluish – green in colour. Digestion converts any nitrogen in the food to ammonia, and other organic matter to CO_2 and H_2O. After digestion, the flask was then diluted with distilled water to about 200ml in the 250ml volumetric flask [2].

$$R\text{-}2NH_2 + 2NaSO_2 + 2H_2SO_4 \rightarrow (NaH_4)_2SO_4 + SO_4 + 2O_{2,\ N(Food)} \rightarrow (NaH_4)_2SO_4$$

ii. Distillation

50ml of the digested sample was pipetted into the Kjeldahl distillation apparatus through the filling part of the apparatus into the inner chamber, 40% NaOH was added and boiled. The ammonia distilled over, then condenses and reacted with a 10ml boric acid indicator to form ammonium borate. The distillation was stopped when the volume of ammonium borate solution reaches 50ml [2].

$$(NH_4)_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2NH_3 + 2H_2O$$

iii. Titration

50ml of the distillate was collected and titrated against 0.1M

HCl

$$(NH_4)_3BO_3 + 3HCl \rightarrow H_3BO_3 + 3NH_4Cl$$

Note: - the procedure was repeated three times on the different part of the samples. See Appendix A (Table 1, 2, and 3).

3. Results

The summary of the protein analysis results obtained in selected meat samples, chicken, cow and rabbit are given in figure 1 below, based on the comparative analysis carried out on protein content in the chosen meat samples.

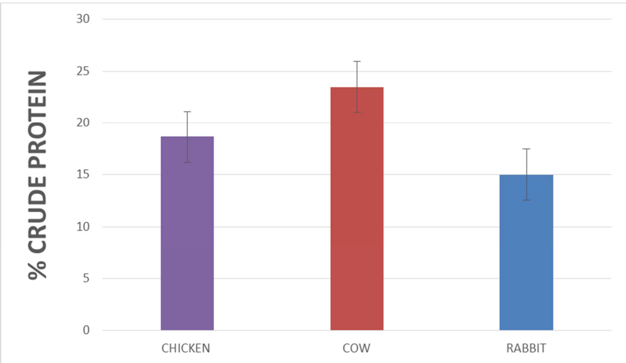

Figure 1. Showing the Bar chart of crude protein in various meat sample.

4. Discussion

Protein is one of the most important essential nutrients in animal tissues. This important nutrient is essential in maintaining a healthy life whereas the insufficient supply of protein can result in many health disorders such as marasmus, kwashiorkor, organ failure, and weak immune system. The research carried out on the comparative analysis of protein content in selected animal meat samples, chicken, cow and rabbit show that all the samples contain protein in different percentages. Thus, the protein and lipid fraction of camel meat underwent considerable changes during refrigerated storage. Therefore, the behaviour of protein and lipid fraction in camel meat during refrigerated storage could provide a better understanding of the processing and storage conditions [13]. These statement then trigger a proper analysis of protein fraction of meat to understand their deteriorating stages.

Table 1-3 of each sample shown in Appendix A revealed that titre values were closed to one another. However, the cow has the highest titre value of 10.75ml, followed by chicken with titre value of 8.53ml and rabbit having the least titre value of 6.86ml. This result is relatively similar to [10] proposed rabbit meat protein oxidation as a potential deteriorative change in refrigerated rabbit meat along with microbial spoilage and lipid oxidation.

The figure in the result shows that cow has the highest crude protein of 23.47%, followed by chicken with crude protein of 18.66% and rabbit with crude protein of 15.00%. Therefore, comparing the protein content in selected meat samples, the above result shows that there are differences in protein contents present in the selected samples. Our result can justify with the work of [14], who reported nitrogen content in various food proteins ranges from 13.4 to 19.1% (1) due to the variation in the specific amino acid composition of proteins. Proteins rich in basic amino acids contain more nitrogen than those missing in basic amino acids.

5. Conclusion

Based on the research carried out, it could be seen from the values obtained through the analysis of each sample that cow has the highest percentage of crude protein followed by chicken and lastly rabbit. With the results obtained from this analysis, Comparative Analysis of Protein Contents in selected meat samples (chicken, cow and rabbit), cow meat is recommended for consumption as compared to other two samples, since it has the highest percentage crude protein than others. Also, it is recommended that future research should be carry out on proximate nutritional analysis and minerals content on meat samples.

Appendix (A)

Table 1. Protein Content in Chicken Meat.

TITRE	BURETTE READING		
	INITIAL(ml)	FINAL(ml)	TITRE VALUE(ml)
1st	0.00	7.80	7.80
2nd	7.80	16.10	8.90
3rd	16.10	25.00	8.90

$$\text{Average titre value} = \frac{7.80+8.90+8.90}{3} = 8.53\text{ml}$$

$$\%\text{Crude protein} = 0.0014 \times 8.53 \times \frac{250}{50} \times \frac{6.25}{2} \times 100 = 18.66\%$$

Table 2. Protein content in cow meat.

TITRE	BURETTE READING		
	INITIAL(ml)	FINAL(ml)	TITRE VALUE(ml)
1st	0.00	9.86	9.86
2nd	9.86	20.72	10.87
3rd	20.72	32.28	11.45

$$\text{Average titre value} = \frac{9.86 + 10.87 + 11.45}{3} = 10.75\text{ml}$$

$$\%\text{Crude protein} = 0.0014 \times 10.75 \times \frac{250}{50} \times \frac{6.25}{2} \times 100 = 23.47\%$$

Table 3. Protein content in Rabbit meat.

TITRE	BURETTE READING		
	INITIAL(ml)	FINAL(ml)	TITRE VALUE(ml)
1st	0.00	7.00	7.00
2nd	7.00	13.86	6.86
3rd	13.86	22.58	6.72

$$\text{Average titre value} = \frac{7.00 + 6.86 + 6.72}{3} = 6.86\text{ml}$$

$$\%\text{Crude protein} = 0.0014 \times \frac{250}{50} \times \frac{6.25}{2} \times 100 = 15\%$$

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