BIOLOGICAL EVALUATION OF VISCERA PROTEINS IN BEEF CATTLE

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THESIS
Submitted in partial fulfilment of
the requirements for the degree of
MASTER OF SCIENCE
(Animal Nutrition)

APROVAL SHEET

Tittle : Biological Evaluation of Viscera Proteins in Beef Cattle.

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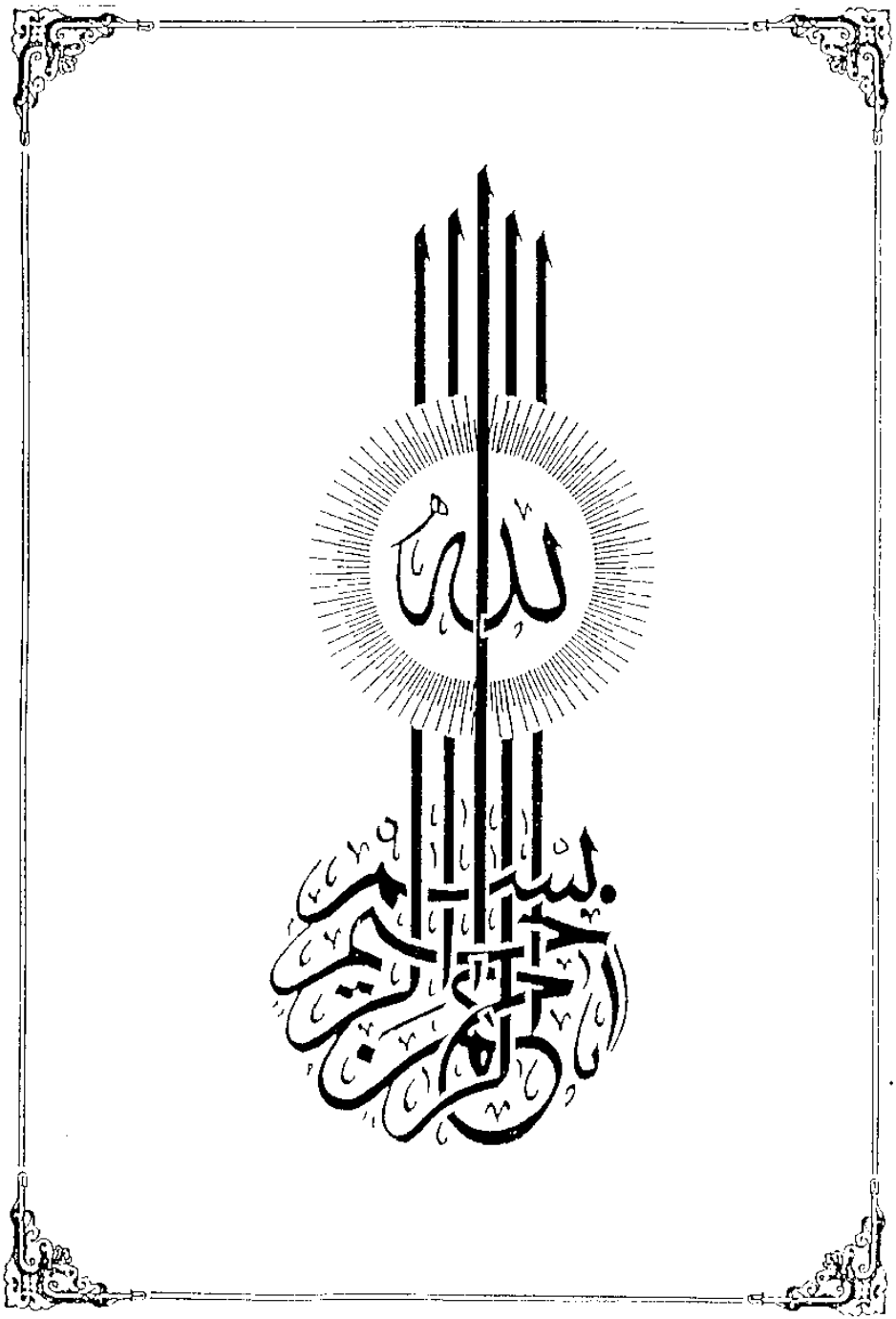
Date: / /19



ACKNOWLEDGEMENT

It is the wish of the auther to express her sincerest gratitude and appreciation to Dr. Osman Shehata, Professor of Nutrition, Dept. of Animal Production, Faculty of Agriculture, Ain Shams University, under whose guidance this study was made, for suggesting the problem, his close supervision and invaluable advice and encouragement he has provided during all phases of this investigation. She is heartily indebted to him for his deep interest and invaluable suggestions and criticism and, much more, for his inspirational role as master and friend.

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INTRODUCTION

The most urgent task facing agricultural scientists all over the world is that of providing food of adequate quality for the rapidly increasing human population. It is a sobering thought that if trends in population continue- and there is little reason to doubt that this will be the case, unless there is speedy change in atitude to the question of controlled fertility, or the quite uncontemplatable holocaust of an atomic war - there will be twice as many mouths to feed in the year 2000 as there were in 1960

The problem is much more than one of supplying sufficient calories,; there is already a shortage of calories supplied as protein, and this situation is likely to become more critical in the years ahead. Yet man does not live by bread, rice or potatoes alone, and for most peoples milk, eggs and meat are essential dietary component if they are to live satisfied and purposeful lives.

Meat is still considered the main dish on the table yet the most expensive item in the menu. Still so many countries are short in meat and the share of their inhabitants is still below that is recommended.

A secondary source of meat, however, is the offals (viscera) which constitute a considerable portion (20 %) of the carcass weight. A choice steer, weighing 450 Kg. yields about 255 Kg. of carcass beef. This remaining 195 Kg. comprises about 22 Kg. of hide, 50 Kg. of edible offals and 123 Kg. of non-edible by products. The utilization of both edible and non-edible offals is an indication of the strict economy practiced by meat plants. Non a single part of the animal is allowed to go to waste.

Offals are always looked upon as a second or even a third class quality kind of meat in the public opinion and, consequently, sold in cheep prices for the poor classes. Justification of the public opinion about the protein quality of the offals has not been proved; as far as the writer is aware, very scare reports, if any, about the nutritive value of offals are known.

The objective of the present work is the biological evaluation of the offal proteins. Protein Efficiency Ratios were determined for the protein of the different parts of offals as compared to meat protein.

From the P.E.R. values obtained the Biological values were estimated. Feed Efficiency Ratios of the diets containing the different viscera protein sources were as well determined.

REVIEW OF LITERATURE

The nutritive importance of proteins and the dependance of animals on plants for these substances were first pointed out by the Dutch chemist G.J. Mulder around 1840. The term Protein was suggested by him as a designation for the universal component of tissues, both plant and animal, and was characterized by him as "Unquestionably the most important of all known substances in the organic kingdom. without it no life appears possible on our planet. Through its means the chief phenomena of life are produced".

Today, more than 135 years after Mulder, the proteins are still "first" (Greek, Proteios) in construction of body tissues and organs, and in the regulation of vital processes, and disturbances in their metabolism are associated with nutritive failure and with many pathologic conditions with which the physician is confronted.

Proteins are normal constituents of all animal cells and body fluids with the exception of the bile and urine. They are essential components of both the protoplasm and the nucleus of the cell; hence they exert a profound influence on growth. They are important in the regulation

of osmotic relations between cells and intercellular fluids and between tissues and blood and play a significant role in the fluid balance of the body. Many of the best characterized enzymes have been obtained in crystalline form and have the properties of proteins (the "protein enzymes"). A considerable number of the hormones, chemical regulators of the body, either are proteins (the so-called protein hormones) or are derivatives of proteins. Many of the substrances associated with immunologic and antigenic reactions and similar phenomena are known to be proteins. Finally a nucleo-protein is the major constituent of cell nuclei and is believed to constitute the chromatin of the nucleus and thus to form the principal component of the chromosome.

The Biological Evaluation Of Proteins:

A. Historical:

The biological evaluation of proteins may be said to date back to 1872 when Carl Voit observed that gelatin was unable to support tissue growth.

The first sustained and productive investigations on this subject were carried out by Osborne and Mendel

from 1911 to 1920 (Mitchell, 1952). Confinding their attention at first to the vigetable proteins that Osborne had previously isolated and analyzed, Osborne and Mendel distinguished between those proteins occuring in foods that are capable of supporting normal growth in the rat, and those are not, the former being complete proteins and the latter incomplete. From such purely qualitative studies they developed quantitative methods of protein appraisal, involving control of the caloric, as well as the protein, consumption of their experimental animals, culminating in their excellent comparative study of casein, lactalbumin, and edestin (1916). In 1919, in cooperation with Ferry, they developed "a method of expressing numerically the growth-promoting value of proteins", involving the determination of the gain in body weight per gram of proteins consumed at that level of dietary protein associated with the highest "protein efficiency ratio". This method was used in an effective comparison of the proteins of barley, oat, rye, and wheat (Osborne and Mendel 1920).

The method of Osborne, Mendel and Ferry has been employed by many investigators in expressing the growth-promoting value of proteins from a wide variety of foods, generally with modifications designed not to improve the precision of the method but to increase it convenience at a saving time. The "protein efficiency ratio" varies from 0 to about 4.5 when the dietary protein makes up about 10 % of the ration and the feeding period lasts from 4 to 6 weeks, starting with weanling rats.

Methods of measuring the nutritive value of proteins from the nitrogen balance of experimental animals subsisting upon diets containing the test protein at an appropriate level commend themselves to the fastidious research workers from whom accuracy is more important than speed. By following the wastage of dietary N in digestion and in metabolism, coefficients of protein utilization can be computed from both. McCollum made such a study on growing pigs in 1914, in comparisons of the proteins of milk, corn, wheat and oats; he expressed the results as percentages of ingested N absorbed (corrected for metabolic fecal N) and percentages of absorbed N recovered in the nitrogen balance. The latter percentages, however, are not true efficiency ratios since they do not credit

the absorbed N with the replacement of the endogenous losses of N, the maintinance requirement of N.

Thomas (1909) proposed a method of computing a "biologische wertigkite" (biological value) of dietary protein in adult human nutrition that credits the absorbed N with both N retention in growth and replacement of endogenous N losses. Thomas makes the following comment on his method, as translated by Mitchell; "For the sake of simplicity, I have not taken into consideration the N loss that the body suffers by way of the outer skin, hair, etc." In later publication, Thomas (1954) states in speeking of his biological value work, "...personally, I never returned to these studies since I was dissatisfied with the N-content determination as a true measure for the protein minimum.

In those days (1913) the nutrition scientist still claimed that animals were not capable of assimilating ammonia or inorganic nitrogen compounds. F. Knoop's observation that keto acids can be converted into optically active acetylated amino acids in normal metabolism was not yet widely known. The general belief was that only plants and microorganisms were capable of this N

assimilation. From Knoop's work it became clear that the biological value of proteins depended less on their nitrogen content than on the carbon skelton of the involved amino acids.

The principle of the Thomas method has been adapted to growing, as well as adult animals, by Mitchell (1924 a). Both methods are based upon the validity in essence of the theory of protein metabolism proposed by Folin. The technique of the Thomas method has been applied, into modification, mainly to growing rats, but also to pigs, sheep, cattle, man and to a limited extent to poultry. The pig is particularly tolerent of the depletion of dispensible protein stores (McCollum 1911) required the body's contributions to feces and urine an intigral part of the method. The biological value of dietary protein in the growing animals may range in the value from 0 to 100, but a value less than about 40 seems to be incompatible with growth, with species differences generally considerable except for the ruminent animal, in which the values obtained by the usual procedure relate not so much to dietary protein as to the microorganisal protein synthesized in the pounch of the animal. In the pig, McCollum (1911) has obsurved a remarkably high utilization