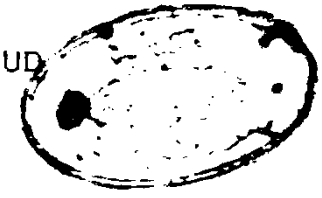
INFLUENCE OF MALNUTRITION ON LENS PROTEINS AND AMINO ACID

Thesis

Submitted In partial Fullfilment for the Master Degree of Science
IN BIOCHEMISTRY

BY

AMANY ABDEL GAFFAR MAHMOUD



Supervised by

PROF. DR. IBRAHIM R. SHIMI

Prof. of Biochemistry
Biochemistry Department
Faculty of Science - Ain Shams University

PROF. DR. FAHMY TAWFEEK ALI

Professor of Biochemistry
Biochemistry Department
Faculty of Science
Ain Shams University

PROF. DR. FAWZY AMIN AL-SHOBAKI

Professor of Biochemical Nutrition
National Research Center

BIOCHEMISTRY DEPARTMENT

FACULTY OF SCIENCE

AIN SHAMS UNIVERSITY

1991

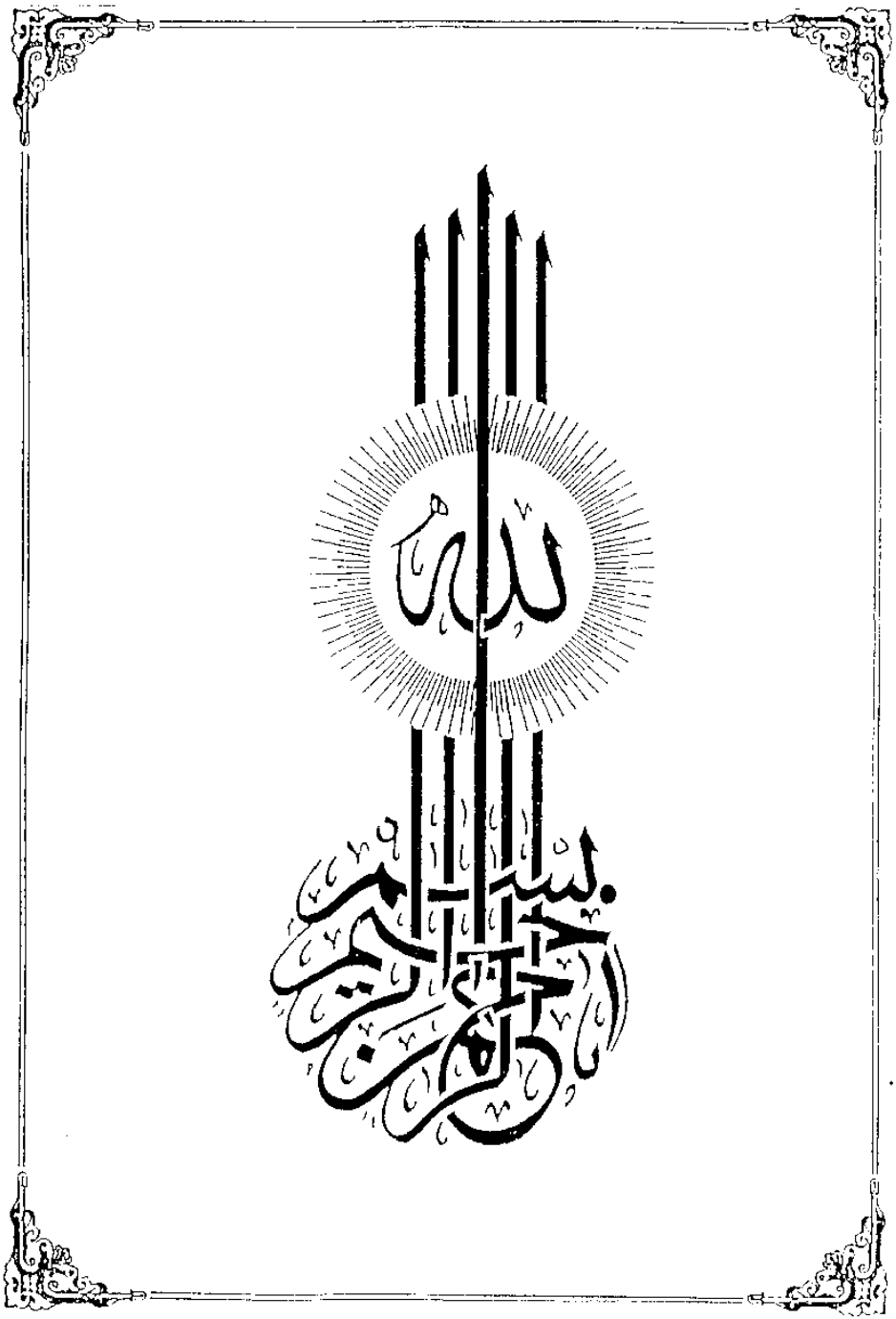
بسم الله الرحمن الرحيم

"وأنزل الله عليك الكتب والحكمة

وعلمك ما لم تكن تعلم وكان فضل

الله عليك عظيما"

صدق الله العظيم (النساء ١١٣)



TO MY MOTHER,

THE MEMORY OF

MY BELOVED FATHER

AND

MY HUSBAND

ACKNOWLEDGEMENT

I am indebted and extremely grateful to *Prof. Dr. Ibrahim R. Shimi*, Prof. of Biochemistry , Faculty of Science, Ain Shams University, for his supervision , his great interest in the work, unfailing advice and valuable discussion.

My deep thanks and gratitude to *Prof. Dr. Fahmy T. Ali*, Prof. of Biochemistry, Faculty of Science, Ain Shams University for constant guidence continuous support and spirtural encouragement.

I owe special gratitude and my thanks to *Prof. Dr. Fawzi A. El-Shobaki*, Prof. of Biochemical Nutrition, National Research Center, for suggesting the point of research, supervising the whole work and for his consistent supervision, valuable suggest-

ions, building scientifically and great effort throughout the work.

I express my thanks and deep gratitude to *Prof. Dr. Magdoline Y. El-Gamal*, Head of Research Institute of Ophthalmology for giving every possible help, and for her continuous support and advices during this work.

I am very grateful and hearthfuly acknowledge the assistance, help and cooperation of all staff members of The Research Institute of Ophthalmology during this work.

CONTENT

PREFACE

Although several investigations are available dealing with the effect of protein deficiency on metabolic reactions in the body, little information can be traced upon the effect on the eye. This study was done to investigate the effect of feeding rats on a protein deficient or depleted diet on the eye lens crystallins, amino acids, sodium and potassium. The effect on Na, K ATPase of the eye lens membrane was also investigated. The change in the amino acid patten of the aqueous humour was assessed.

The chromatographic analysis of the lens proteins revealed a diminution in the γ-crystallin fractions and a relative increase in the B_1, B_2-crystallins of rats fed on the protein deficient diet. In rats fed on the protein depleted diet the γ-fraction shifted to a higher molecular weight level on the chromatographic elution pattern and there was a drop in α-crystallin fraction and a slight increase in the B_1, B_2-crystallins.

The electrophoretic separation of these crystallins on cellulose acetate proved that protein deficiency or depletion causes change in the sequence and intensity of the different bands corresponding to different crystallins.

Analysis of the amino acids pattern of the lens with the automatic amino acid analyzer showed that protein deficiency causes a drop in certain amino acids particularly threonine. Feeding rats on protein depleted diet also caused a drop in most amino acids of the lens. The amino acid content of the aqueous humour was also affected by the condition of protein deficiency or depletion.

A change in the level of sodium and potassium in the eye lens was reported due to protein deficiency or depletion. Besides, the Na, K-ATPase activity was markedly decreased.

These findings were discussed within the frame of the similar work found in the literature. It was concluded that the effect of protein deficiency or depletion can extend to the eye causing changes in the lens crystallin pattern, the amino acid content, the sodium, potassium and the eye lens membrane ATPase togeher with a change in the amino acid pattern of the aqueous humour. Some of these changes are similar to those that associate certain type of cataract. It is believed that if the condition of protein deficiency or depletion are aggravated there is a risk that the visual power is affected and the occurance of lens cataract becomes possible. We advise that protein deficiency particularly among infants is handled carefully during the early stages of the disease to avoid further complications on the eye.

INTRODUCTION

Malnutrition is a world wide problem facing in particular the underdeveloped countries. Protein deficiency is a serious nutritional problem that affect the population especially infants and young children (Scrimshaw et al., 1968). The syndrome reflects itself by drastic complications upon the child. Protein deficiency may not be necessarily due to the poverty but also can be the result of ignorance of the proper nutritional regulations (Williams, 1985). In addition to this famines occuring in different countries due to environmental reasons, also contribute to the problem of shortage in food supply.

Several investigations were done to characterize and to give full description of changes occuring in metabolic process that associate protein deficiency (Madi et al., 1970; Phillbrick and Hill 1974; Atallah, et al., 1977). In spite of this, little information are available describing the changes that occur in the eye lens due to deprivation in protein in food. Such changes are so serious because they affect an important organ and are quite dangerous threatening the eye vision.

The aim of the present work is to investigate the changes that occur in the eye lens due to feeding on a protein deficient or depleted diet. The eye lens

crystallins which are the main types of proteins present in this compartment and which are vital in the transparency of the eye lens (Blomendal 1981) were studied. The changes that occur in the aqueous humour which is the liquid mediating transfer of nutrients to the lens (Graymore. 1970a) were also investigated. Amino acids, sodium. Potassium and lens membrane Na. K-ATPase which are important constitutents performing regulatory functions in the eye (Bonting. 1965: Piatigorsky 1980: Chauhan. et al.. 1984) were also included in our study.

CHAPTER 1

LITERATURE REVIEW

LITERATURE REVIEW

1.1 MALNUTRITION:

Malnutrition is the result of a complex web of factors:. psychologic, personal, social, cultural, economic, political and educational. Each of these factors is a more or less important cause of malnutrition at a given time and place for a given individual.

Just as there are many factors and forces within a family's house that interact to influence its members, so there is an even more vast complex of interrelated forces housed in a biologic system that produces disease. Many ecological factors work together to produce malnutrition. Some of the many related causes of malnutrition can be classified under the three factors that are classically cited by the epidemiologist as the triad of variables that influences disease:. (1) agent (2) host (3) Environment

(1) AGENT:

The fundamental agent of a malnutrition disease is a lack of food. Various factors may cause or modify this lack of food: inadequate quantity and quality of food, insufficient amounts for children during critical growth periods, and loss of supply through famine, poverty or maldistribution.